Online Social Networking and Adolescent Mental Health

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Statement of Originality

I, Amanda Elizabeth Fahy, confirm that the research included within this thesis is my own work or that where it has been carried out in collaboration with, or supported by others, that this is duly acknowledged below and my contribution indicated. Previously published material is also acknowledged below.

I attest that I have exercised reasonable care to ensure that the work is original, and does not to the best of my knowledge break any UK law, infringe any third party's copyright or other Intellectual Property Right, or contain any confidential material.

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Details of collaboration and publications:

The concept for this thesis originated with the author and was developed with supervision from Dr Charlotte Clark and Professor Stephen Stansfeld. The author selected all cyberbullying measures and the social anxiety measure for inclusion at baseline and follow-up. The decision to include the measure of depression and well-being was made by the wider ORiEL research team. While completing this PhD the author worked full-time as a research assistant on the ORiEL study. As part of this work as a research assistant, the author was responsible for recruiting schools to the study, organising fieldwork, and leading the survey sessions at baseline and follow-up. The author was responsible for administration involved in tracking participants longitudinally, for liaising with the data entry company, for cleaning the data, and for arranging dissemination materials. Dr. Neil Smith, the ORiEL quantitative survey manager compiled the data dictionaries and was responsible for coding the ethnicity variable used here. The author is responsible for deriving all other variables, designing

the analysis plan and carrying out study analyses. Multiple imputation of missing data was carried out by the author with guidance from Dr. Melanie Smuk and Dr. Charlotte Clark. This thesis has been entirely written by the author and all work carried out by the author has been under the supervision of Dr. Charlotte Clark and Professor Stephen Stansfeld.

Abstract

Background

This study examines longitudinal associations of frequency of social media use, cyberbullying involvement, and online social network characteristics with depressive symptoms, social anxiety symptoms, and mental well-being at one year follow-up in a multi-ethnic sample of early adolescents living in areas of East London characterised by high levels of deprivation. Studies of the impact of adolescent social media use on mental health have primarily used cross-sectional data; longitudinal research is needed to investigate temporality and lasting mental health effects.

Method

Longitudinal analyses (n=2480) of data from the NIHR funded Olympic Regeneration in East London (ORiEL) study examined the impact of baseline (aged 12-13) social media use including: frequency of instant messaging (IM) and social networking site (SNS) use, cyberbullying, and online network characteristics (network size and communication with strangers); on adolescent mental health outcomes including depression (measured using the Short Mood and Feelings Questionnaire), social anxiety (measured using the Mini Social Phobia Inventory) and well-being (measured using the Warwick Edinburgh Mental Well-being Scale) one year later.

Results

After adjustment for gender, ethnicity, socioeconomic status, school and baseline mental health, cybervictims (13.6%) and cyberbully-victims (20.4%) had greater odds of reporting symptoms of depression (victims: OR=1.44, 95% CI [1.00, 2.06]; bully-victims: OR=1.54 95% CI [1.13, 2.09]), and symptoms of social anxiety (victims: OR=1.52, 95% CI [1.11, 2.07]; bully-victims: OR=1.44 95% CI [1.10, 1.89]) than their uninvolved peers. Communication with strangers (24.7%) was also associated with increased odds of depression (OR=1.35, 95% CI [1.04, 1.76]) at follow-up.

Conclusions

Poorer mental health outcomes were reported by students who encountered risks online (i.e. those using IM at high frequencies, those who communicated with strangers online, and those victimised by cyberbullying). Given the prevalence of these risk factors, clinicians and public health practitioners should address social media activity when assessing adolescent mental health.

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Glossary of Terms and Abbreviations

List of acronyms and abbreviations used throughout the thesis (alphabetical order)

Adj.	Adjusted (used in table footnotes)
BBM	Blackberry Messenger
CI	Confidence interval
DSMM	Differential Susceptibility to Media Effects Model
IM	Instant messaging
MAR	Missing at random
MI	Multiple imputation
MICE	Multiple imputation by chained equations
Mini-SPIN/mSPIN	Mini social phobia inventory
MNAR	Missing not at random
NCGM	Net Children Go Mobile Study
NIHR	National Institute for Health Research
OR	Odds Ratio
RRR	Relative Risk Ratio
SD	Standard deviation
SES	Socioeconomic Status
SNS	Social networking site(s)
SMFQ	Short moods and feelings questionnaire
WEMWBS	Warwick Edinburgh Mental Wellbeing Scale
WHO	World Health Organisation

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CHAPTER ONE

INTRODUCTION TO PHD

1 CHAPTER ONE: INTRODUCTION TO PHD

1.1 Conceptual Framework

This PhD study aims to examine and contribute to the understanding of associations between social media technologies and adolescent mental health. The growing global focus on mental health represents an important opportunity to target adolescent mental health (Sawyer et al., 2012). Half of all lifetime mental health diagnoses begin by 14 years of age (Kessler et al., 2005) and there are sensitive periods throughout childhood and adolescence in which social experiences can have a disproportionate impact on future mental health (Hertzman & Boyce, 2010). Identifying the social determinants of adolescent mental health is critical if effective, preventative public mental health interventions are to be designed and implemented (Marmot, 2014).

This PhD focuses specifically on internalising mental health symptoms. During adulthood, internalising disorders, such as depression, are one of the largest causes of health burden (Murray et al., 2013) and the onset of adolescence (from about age 10) has been recognised as a critical period in terms of the emergence of depression and other symptoms of psychological distress (Andersen & Teicher, 2008; Costello, Egger, & Angold, 2005; Steinberg, 2005). It is estimated that one third of individuals will experience a mental illness at some point in their lifetime (Steel et al., 2014). Adolescent internalising symptoms, specifically symptoms related to anxiety and depressive disorders, predict mental health problems and diagnoses in adulthood (Clark, Rodgers, Caldwell, Power, & Stansfeld, 2007; Fergusson & Woodward, 2002; Patel, Flisher, Hetrick, & McGorry, 2007). This study investigates internalising symptoms by focusing specifically on adolescents' symptoms of depression and social anxiety. Symptoms of depression include sad mood, feelings of worthlessness, feelings of hopelessness and anhedonia (Davila et al., 2012) while social anxiety may be defined as the fear, worry or apprehension experienced by individuals when thinking about failing to be positively perceived by others (Schlenker & Leary, 1982).

In the past, definitions of mental health have focused on an understanding of mental health as the absence of psychopathologies or mental illnesses such as depression and anxiety (Westerhof & Keyes, 2010). Recent conceptualisations of mental health, however, argue that mental health research should also take optimal mental well-being into account. The World Health Organisation (2004 pg. 2) provided a more positive definition of mental well-being suggesting that it is ‘‘a state of well-being

in which the individual realises his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community''. This study extends previous research by adopting a two-continua model (Westerhof & Keyes, 2010) in approaching mental health by focusing on mental illness (symptoms of depression and social anxiety) and on mental well-being.

Social support from family and peers represents one established social determinant of mental health (Viner et al., 2012). Indeed, substantial research evidence has amassed over the past number of years which points to a positive, causal association between social ties or social support and mental health (Cohen, Underwood, & Gottlieb, 2000; Stansfeld, 2005; Umberson & Montez, 2010). However, the increased importance of peer relationships during adolescence may also increase the risk of rejection and conflict (Bakker, Ormel, Verhulst, & Oldehinkel, 2010) which can impact detrimentally upon adolescent mental health (Graham & Bellmore, 2007). From a relationship perspective, it is believed that social support directly impacts mental health as a result of the interpersonal processes underpinning that support (Cohen et al., 2000). That is, specific features of social relationships (including social isolation, social integration, the quality of social relationships, and characteristics of social networks) may directly influence mental health outcomes (Christakis, Moreno, Jelenchick, Myaing, & Zhou, 2011).

In an adolescent context, media use (including watching television, using the internet, and social media use) is recognised as a key socialising agent for young people (Strasburger, 2009). Adolescents today are the first generation to grow up immersed in a world of social media (Ahn, 2011; Palfrey & Gasser, 2008). They spend more time online and interact more online than adults (Valkenburg & Peter, 2009) and their use of social media (e.g. Facebook, Twitter, Instagram, WhatsApp, BBM) often represents an apparently seamless extension of their offline worlds into the online domain (Kift, 2007). However, this rise in popularity of social media among adolescents (McBride, 2011) means that adolescent interaction within social relationships is changing. But what does this new online face of adolescent social experiences mean for adolescent mental health? Public concern related to this issue has been endemic in recent years and has been typified by the volume of content on this topic in the mainstream media, and headlines such as: “Not enough done to tackle cyberbullying, warns NSPCC”

(Whitworth, 2012); “Cyberbullying contacts to ChildLine up by 87%” (Sedghi, 2014); “Mental health of children and young people ‘at risk in digital age’” (Campbell, 2014).

As discussed in the literature review (Chapter Two), the affordances of social media are largely aligned with adolescent priorities in terms of adolescent personal and social development (Valkenburg & Peter, 2011). Previous research has also, however, identified a number of features of online communication which distinguish it from offline communication (Bonetti, Campbell, & Gilmore, 2010; Peter, Valkenburg, & Schouten, 2005) and suggest that face-to-face and online manifestations of social relationships may not be interchangeable (Pea et al., 2012). This PhD has been designed to add to our understanding of the mental health impact of adolescent social media use, underpinned by the motivation to identify ways in which effective, public health interventions might be designed to improve the mental health of adolescents. The literature review (Chapter Two) outlines current understanding of the way in which communication via social media may impact social relationships and mental health. The literature review also highlights gaps in knowledge and the scarcity of high-quality empirical research on this topic.

1.2 Research Questions

The relationship perspective regarding associations between social support and mental health emphasised the direct association between social relationship characteristics and mental health outcomes. The current study applies this perspective in an online context and represents the first study to look longitudinally at the way in which adolescent mental health is impacted by the characteristics of their social media use. This study is underpinned by the following primary research question:

1. **How is the mental health of adolescents impacted by the characteristics of their social media use?**

To answer this question, three broad characteristics of social media use and online relationships have been identified:

A) **Frequency of social media use:** This characteristic describes *how often* adolescents use social media. The focus of this section is on the extent to which adolescents are integrated in social media based communication.
B) **Cyberbullying:** This characteristic relates to *what* the adolescent does on social media. The focus of this section is on online conflict and whether

adolescents are involved in cyberbullying online as a cybervictim, cyberbully, or cyberbully-victim.

C) **Online communication networks:** This characteristic focuses on *who* adolescents communicate with online. The focus of this section is on the characteristics of adolescents' online social networks including the size of adolescents' online communication networks on their most used social networking site and on whether adolescents communicate with strangers online.

The literature review has been written to highlight the way in which the above three characteristics of adolescent social media use have been examined in the past and to illustrate current understanding of the association between each of these characteristics and adolescent mental health outcomes.

The secondary aim of this study is to examine the role of individual factors in associations between social media use and adolescent mental health. Exploratory research is needed to identify whether certain groups of adolescents are particularly at risk of poorer mental health outcomes related to the characteristics of their social media use (Livingstone & Smith, 2014). Very little is known about what personal characteristics might be salient in relationships between characteristics of social media use and adolescent mental health. This study aims to contribute to the literature by exploring the following two additional research questions:

2. **How might the pathways from characteristics of social media use to adolescent mental health differ for males and females?**
3. **What role might peers and parents play in buffering or exacerbating the impact of the characteristics of adolescents' social media use on their mental health?**

This study makes a number of novel contributions to research in this field. Most notably, it is the first study in the UK to examine longitudinal associations between the characteristics of adolescents' social media use and their future mental health. As such, the study findings are of direct relevance to public health researchers and policy makers interested in adolescent mental health. In addition, to the best of my knowledge, this is the first study to compare use of social networking sites (SNS) and instant messaging (IM) separately in terms of their mental health outcomes; the first to examine longitudinal associations between involvement in cyberbullying as a cyberbully (i.e.

someone who perpetrates cyberbullying), as a cybervictim (i.e. someone who is the target of cyberbullying), and as a cyberbully-victim (i.e. someone who both perpetrates and is victimised by cyberbullying) and adolescent mental health; and the first to examine longitudinal associations between adolescents online network characteristics and adolescent mental health. The robust epidemiological methodology used in this study contributes to literature in this field as the strength of the evidence for the study conclusions is enhanced. A more detailed discussion of the strengths of this study is outlined in the discussion in Chapter Six.

This PhD has been designed to address the primary and secondary research questions by conducting a thorough literature review on current empirical research in this field followed by empirically testing the study hypotheses which have been derived from the study research questions. The study hypotheses are outlined in the literature review (Chapter Two) and these will be tested using two waves of data collected one year apart from a multi-ethnic cohort of over 2000 early adolescents (aged 12-13 at baseline) attending 25 schools in four East London boroughs characterised by high levels of deprivation. This PhD aims to increase the understanding of the way in which adolescents use social media and how that use is associated with their mental health outcomes. In addition, the PhD indicates how research methodology in this field can be strengthened in order to improve our ability to design interventions to improve adolescent mental health in the future.

1.3 Thesis Outline

The central aim of this thesis is to examine how adolescent social media use is associated with mental health outcomes one year later. This introductory chapter illustrates the conceptual framework underpinning this study and outlines the primary and secondary research questions upon which this study has been designed. The thesis is divided into six chapters. Following this introductory chapter, Chapter Two details the study literature review. The literature review has been subdivided into two sections. Section 2.2 focuses on existing literature related to the primary research question (outlined below) and identifies the specific hypotheses being tested to answer this primary question, while Section 2.3 addresses current literature and hypotheses related to the two secondary research questions. The literature review culminates in a discussion of this PhD study, providing details on the gaps in the literature which this study aims to address.

Chapter Three outlines the study methodology including the study design, measurement instruments, procedures, and statistical analysis plan, while Chapters Four and Five detail the study results. Specifically, Chapter Four includes results related to the primary research question which investigates associations between characteristics of social media use and adolescent mental health while Chapter Five includes results related to the secondary research questions pertaining to the role of gender, peer and family factors in associations between characteristics of social media use and adolescent mental health. Finally, Chapter Six provides a full discussion of this PhD study including consideration of the study results in relation to the study hypotheses and previous literature, a critique of the strengths and limitations of the study methodology, consideration of the original contributions of this study, and recommendations for future research and intervention.

CHAPTER TWO

LITERATURE REVIEW

2 CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

How is the mental health of adolescents associated with the characteristics of their social media use? As outlined in Chapter One, three key characteristics of social media use are examined in order to answer this primary research question. These are: frequency of social media use, cyberbullying involvement, and online network structure. The first section of this literature review examines each of these characteristics in turn. Definitions and prevalence rates related to each characteristic of social media use are provided, while the main focus is on current theory and empirical evidence linking each of these three characteristics to adolescent mental health outcomes. Following this, existing theoretical and empirical evidence examining the potentially moderating role of gender and perceived social support and parental monitoring in associations between the characteristics of social media use and adolescent mental health is outlined. The literature review ends with a consideration of the methodology to be used in this study and the gaps in the literature addressed by this research.

2.2 Characteristics of Social Media Use and Adolescent Mental Health

2.2.1 Frequency of social media use and adolescent mental health

In recent years, the rise of social media use has led to the emergence of a multidisciplinary field of research aimed at better understanding the benefits and harm associated with its use. The multidisciplinary nature of research in this area means that research has been carried out from a number of different conceptual perspectives. This PhD is situated in the field of psychiatric epidemiology and is therefore underpinned by the aim of identifying risk and protective factors associated with adolescent mental health outcomes. A key goal of psychiatric epidemiological research is to identify modifiable factors linked to adolescent mental health with a view to translating epidemiological research findings into effective, population-based interventions which will improve mental health outcomes.

The way in which this study focuses on different characteristics of social media use including frequency of use, cyberbullying involvement, and online network structure, enables a synthesis of research across a number of disciplines. Broadly, three alternative approaches to research in this area have been identified in this review of the relevant literature. One approach is characterised by researchers interested in media

effects research. With the emergence of social media, media effects researchers have expanded their interests beyond the cognitive, emotional, attitudinal, and behavioural effects of traditional media forms (e.g. television, radio) and content (e.g. violent or sexual content) to include a focus on the effects of newer forms of social media (e.g. social networking sites (SNS) such as Facebook). Current theories relating to media effects, such as the *differential susceptibility to media effects model (DSMM)* (Valkenburg & Peter, 2013) suggest that media effects (including media effects on physical and mental health and media effects on behaviour and attitudes) are influenced by the type of media being used (e.g. television, internet, games consoles), are conditional on individual factors (e.g. personality, socioeconomic factors), are transactional (i.e. they lead to subsequent changes in media use), and are mediated by immediate response states elicited by that particular form of media use.

A second approach which has led to research on the impact of social media use on individuals' lives relates to research into the features of computer-mediated communication which distinguish it from offline face-to-face communication and how that might impact upon users' behaviour, emotions, responses, and in turn, their social experiences. Much debate has existed in this area between proponents of the *social displacement hypothesis* and those supporting the contrasting *stimulation hypothesis*. The *social displacement hypothesis* posits that time spent using media displaces time that could have been spent elsewhere and that through this displacement social relationships become impaired (Strasburger, Jordan, & Donnerstein, 2010). In contrast, *the stimulation hypothesis* suggests that social media use may benefit offline relationships as online self-disclosure may strengthen existing offline relationships (McKenna & Bargh, 2000). The argument for this hypothesis is that the inherently social functions of social media may enable social media use to represent a source of social support during adolescence (Morgan & Cotten, 2003), which has previously been shown to be associated with mental health (Kawachi & Berkman, 2001; Stansfeld, 2005; Stansfeld, Fuhrer, & Shipley, 1998).

A third approach to research on the associations between social media use and adolescent mental health has stemmed directly from offline research focusing on associations between specific adolescent behaviours and mental health. Researchers have begun to explore the way in which specific adolescent behaviours have migrated online. Most notably, this includes researchers interested in aggression, bullying, and violent behaviour among adolescents. These researchers have begun to explore the way

in which these behaviours have migrated online, and how that online aggression, bullying, and violent behaviour is related to adolescent mental health (Li, 2007; Patchin, 2006; Slonje & Smith, 2008; Smith et al., 2008). Additionally, some researchers have focused on adolescent behaviour online in the broader context of adolescent risk-taking behaviour. The researchers in this area are broadly interested in adolescent risk-taking from a developmental perspective and its outcomes in terms of adolescent mental health and have begun to explore exposure to harm in both online and offline worlds. In terms of online risk-taking behaviour, researchers have focused on aspects of social media use including online communication with strangers and online disclosure of personal information (Escobar-Chaves & Anderson, 2008; Livingstone & Helsper, 2007; Peter, Valkenburg, & Schouten, 2006). Similarly, some researchers have explored factors which protect adolescents from engaging in risk-taking behaviour and emerging protective factors in an online context (e.g. social support (Oh, Ozkaya, & LaRose, 2014), specific coping styles (Vollink, Bolman, Dehue, & Jacobs, 2013), parenting behaviour, and adolescents' media literacy (Leung & Lee, 2012)).

For this PhD, I have taken a psychiatric epidemiological approach to examining the associations between the characteristics of social media use and adolescent mental health for the following reasons: First, the application of a psychiatric epidemiological approach to research in this field places a clear emphasis on adolescent mental health outcomes and enables a synthesis of research from these alternative perspectives into a single study in a way that has not been done to date. Second, this psychiatric epidemiological approach also shifts attention away from simply identifying online risk or protective factors (e.g. excessive use of social media, cyberbullying involvement, and communication with strangers or very large networks of contacts, social support, and parenting behaviour) to a more clear focus on the evidence for harm or benefit resulting from such risks, in relation to mental health specifically. A recent review of research relating to online risks has advocated for the need for more high quality studies investigating the harm associated with risks encountered online (Livingstone & Smith, 2014) in order to generate more effective policies, public health interventions, and clinical approaches designed to protect young people. This study aims to contribute to research on the harm and benefit to mental health associated with adolescent social media use.

A discussion of current research into associations between social media use and adolescent mental health requires an understanding of the way in which social media

use has been defined and measured in previous studies. It is important to consider the way in which conclusions drawn from previous studies related to mental health correlates of social media use may have been predicated around the way in which social media has been conceptualised and the time frames under consideration.

2.2.1.1 Definition of social media use

Forms of social media include social networking sites (e.g. Facebook, Twitter), instant messaging services (e.g. BBM, iMessage, WhatsApp), video and photo sharing platforms (e.g. YouTube, Instagram), and blogs (e.g. Tumblr). Each of these web-based technologies facilitates social interaction in some way via mobile and desktop technologies (O'Keeffe & Clarke-Pearson, 2011) by enabling self-disclosure and self-presentation and by allowing users to shape their social presence in the online world (Kaplan & Haenlein, 2010).

This study focuses specifically on Instant Messaging (IM) and Social Networking Site (SNS) use. IM involves "sending real time messages to another internet user [and] users can create a list of welcome guests and receive alerts when a message is received" (Pujazon-Zazik & Park, 2010, p.78), while SNS are "web-based services that allow individuals to (i) construct a public or semi-public profile within a bounded system, (ii) articulate a list of other users with whom they share a connection, and (iii) view and traverse their list of connections and those made by others within the system" (Boyd, 2007, p.211). SNS may include IM features, though they also offer additional functions including the ability to find old friends or make new friends, to have public networks of friends, and to view news feeds and activity updates detailing what is happening in the lives of those within their networks (Subrahmanyam & Greenfield, 2008b). SNS provide users with an online environment for self-presentation, identity formation and communication within a network of their personal ties (Lee, Lee, & Kwon, 2011).

IM and SNS are both primarily used to communicate with known others (i.e. individuals also known to users in the "real" world) (Subrahmanyam, Reich, Waechter, & Espinoza, 2008) and previous research has suggested that online communication is more strongly associated with individual well-being when that communication is with known others (Valkenburg & Peter, 2007a). Therefore, this study focuses on IM and SNS use as use of these platforms may show stronger associations with adolescent mental health than use of other social media platforms.

As highly popular forms of social media, IM and SNS may represent key socialising factors in the lives of the adolescents who use them. In addition, as identified by researchers interested in computer mediated communication (CMC) and its links to face-to-face communication, a number of characteristics of online communication distinguish it from communication in the real world in ways that may have a significant impact on adolescent mental health. For example, social media use can foster an "online disinhibition effect" (Suler, 2004), whereby certain individuals may self-disclose or act out more frequently or more intensely online than they would in person, which may impact upon their mental health or upon the mental health of those with whom they communicate online. The "online disinhibition effect" is discussed further below in relation to its potential role in cyberbullying. Differentiating different types of social media use, as is done in this study by focusing on IM and SNS separately, may be a useful way of identifying which specific types of social media use may be associated with adolescent mental health. This approach aims to avoid overgeneralising findings, as different types of social media use may have different functions for adolescents (Romer, Bagdasarov, & More, 2013), which may lead to different effects on their mental health. Most previous studies have either grouped all forms of online communication together or focused specifically on SNS use. To date, no study has made the distinction between IM and SNS use in terms of their links to adolescent mental health – a gap which will be addressed in this study.

2.2.1.2 Prevalence of social media use among adolescents

Given the wide variety of social media on offer, we need to better understand the function, benefits and risks involved with different forms of social media (Pollet, Roberts, & Dunbar, 2011). When exploring the impact of social media use on adolescents, researchers have conceptualised "use" of these technologies in different ways. At present, the EU kids online project (Livingstone & Haddon, 2009) and the Net Children Go Mobile study (Livingstone et al., 2014) represent two of the largest studies of adolescent social media use with participants from several countries across Europe, including the UK, involved in each study. As such, the findings relating to prevalence of use obtained from these studies are directly relevant to the UK population. In order to allow comparison between prevalence rates obtained for this PhD study and these larger scale international studies, similar frequency measures of social media use have been used in this PhD.

Young people have embraced the ease of connectivity and social control enabled through the use of SNS and IM. Findings of the EU Kids online Study (Livingstone, Görzig, & Ólafsson, 2011a) indicated that 59% of 9-16 year olds across 25 countries in the EU have a social networking profile – including 26% of those aged 9-10, 49% of those aged 11-12, 73% of those aged 13-14, and 82% of those aged 15-16. Within the UK 67% of 9-16 year old students reported having a social networking profile, higher than the EU average, indicating the popularity of social media among this population of 9-16 year olds.

As an alternative to frequency measures, other studies have focused on the penetration of a given form of social media and its popularity, or on the amount of time spent using social media. The technology penetration rate (i.e. the length of time it takes 50 million people to use them) has increased dramatically over the past century from the advent of the radio (38 years) and phone (20 years) to the recent emergence of the iPad which had 50 million users within just 2 years (Giedd, 2012). New technology is now rapidly embraced within our society, particularly among adolescents. With more and more sites coming online, adolescents are engaging in increasing amounts of communication via electronic means (Livingstone & Brake, 2010). In addition, the number of members that social networking sites (such as Facebook) boast is ever growing. From its naissance in 2004, the popularity of Facebook has grown at a rapid rate to a massive 500 million users spending a total of 700 billion minutes logged in and posting an enormous 30 billion items onto the site each month by 2010 (Paradise & Sullivan, 2012).

In addition to the increasing number of social media technologies available and the growing proportion of people spending increasing amounts of time utilising social media resources, the accessibility of social media is ever-expanding. The ways in which social media may be accessed and the convergence of technologies supporting their use means that it is now easy to connect to social media on your phone in addition to your laptop or computer (Subrahmanyam & Greenfield, 2008a) and social media may also be accessed through the television and other digital devices such as games consoles (Livingstone & Bober, 2005).

Though there are age constraints in terms of the age at which adolescents are allowed to create accounts on social media sites, these are often not adhered to. For example, the minimum age for using Tuenti (a Spanish social networking site) is 14

though many younger adolescents have accounts (Apaolaza, Hartmann, Medina, Barrutia, & Echebarria, 2013). In addition, Barbovschi, Macháčková, and Ólafsson (2015) found that 42% of 9-12 year olds taking part in the NCGM study (2012-1014) reported having a Facebook profile, many with their parents' explicit permissions, which, coupled with the above figures indicates that these age restrictions may not be adhered to within the adolescent population.

A number of studies have been conducted to measure the amount of time young people are spending communicating with one another via electronic means. In the UK, by 2010 the research figures suggested that the average time spent using digital media per day for adolescents aged 12 to 15 was five hours 15 minutes. Given that 15% of this time was found to be spent using more than one media simultaneously, the overall exposure figures were estimated at six hours nine minutes per day (Ofcom & GFK, 2010). It is expected that these exposure times are even higher now as social media usage is likely to have increased since then. In addition, nearly two thirds of adolescents taking part in the NCGM study indicated that the internet gets in the way of time they should spend with family or friends, or doing schoolwork (Livingstone et al., 2014).

In summary, regardless of which form of measurement is selected, it is apparent that social media use has increased dramatically in recent years. Today's adolescents live in media saturated worlds (Brown & Bobkowski, 2011) and spend more time using media (including social media) than they do in any other activity including school, and sleeping (Strasburger et al., 2010). Indeed, adolescents may be considered the defining users of the internet (Valkenburg & Peter, 2009). As a result, media effects researchers argue that the media represents one of the leading socialising influences on adolescents and as such should never be ignored when researching adolescent behaviour (Strasburger, 2009).

2.2.2 Impact of social media use on adolescent mental health

As outlined in the introduction to this literature review, broadly speaking, researchers from three different theoretical backgrounds have carried out research in this field: media effects researchers, researchers comparing computer-mediated communication (CMC) with face-to-face communication, and researchers focusing on the online migration of specific offline behaviours. The first two categories of researchers – those interested in media effects and those comparing CMC and face-to-face communication – have examined associations between frequency of social media

use and adolescent mental health. Each of these perspectives offers some insight into possible links between frequency of SNS or IM use and adolescent mental health. Broadly speaking, research into associations between social media use and mental health has addressed two primary concerns: i) links between heavy or compulsive internet use and mental health and ii) links between social media use, social relationships, and mental health. Media effects researchers have primarily focused on the impact of heavy or compulsive internet use while those interested in CMC have focused primarily on associations between social media use and social relationships which in turn is linked to mental health.

2.2.2.1 Heavy social media use and adolescent mental health

Media effects research emphasises the way in which the internet has changed the way people use media (Romer et al., 2013). Multiple media forms are now available online (including television, radio, news) and the emergence of social media has seen a marked shift from mass communication to mass self-communication as the general public now not only consume media but are also heavily involved in generating and sharing media content via social media (Romer et al., 2013). Findings from media effects research suggest that heavy internet use (>4 hours per day) is correlated with multiple risk behaviours including meal skipping, obesity, sleep problems, and other health problems (Kim et al., 2010), and media effects researchers have suggested that using the internet for communication purposes is more strongly associated with compulsive internet use than other forms of internet use (Fioravanti, Dèttore, & Casale, 2012; van den Eijnden, Meerkerk, Vermulst, Spijkerman, & Engels, 2008).

In an examination of the links between heavy internet use and mental health Romer et al. (2013) studied 14 to 24 year olds in the US (n=719, follow-up response rate 58%). Two clusters of heavy internet users were identified in this study – heavy internet users for gaming and heavy internet users for communication purposes. Unadjusted linear regression analyses suggested that both of these groups reported increased depressive symptoms at one year. In addition, Bélanger, Akre, Berchtold, and Michaud (2011) also found that heavy internet use was associated with increased depressive symptoms among adolescents aged 16 to 20. Further support for the theory that heavy media use is associated with increased depressive symptoms stems from research by Primack, Swanier, Georgiopoulos, Land, and Fine (2009). Using a psychiatric epidemiological approach, Primack et al. (2009) found that high levels of overall media use during adolescence was associated with increased odds of depressive

symptoms at a seven year follow-up (OR=1.05, 95% CI [1.0004-1.10]). Notably however, the effect sizes reported in this study were very small.

Rather than focusing exclusively on harm associated with heavy levels of media use, media effects researchers have also considered the popularity of media among adolescents. As internet use is widespread among adolescents, it is plausible that non-use of the internet, and of social media specifically, by adolescents may be associated with poorer mental health. This argument is supported by findings from the aforementioned study by Bélanger et al. (2011), who found evidence for a negative curvilinear association between internet use and poorer adolescent mental health as adolescent non-users of the internet reported poorer mental health than their moderate-user peers. This study focused on internet use as a broad construct encapsulating browsing online, using social media, and any other online activity. Given the popularity of social media use among adolescents it is plausible that this u-shaped association may exist for associations between social media use specifically and adolescent mental health and this study aims to examine whether both high levels of social media use and non-use of social media are associated with poorer mental health outcomes among adolescents.

Thus, building on the above arguments that both heavy use and non-use of social media may be linked to poorer adolescent mental health, it is important to consider empirical evidence to support the notion that moderate use of social media may be positively associated with adolescent mental health. Indeed, internet use for communication purposes (i.e. social media use) may be associated with lower levels of depressive symptoms compared to internet use for non-communication purposes (i.e. browsing on websites, gaming, and watching videos online). For example, Bessière, Kiesler, Kraut, and Boneva (2008) carried out a study to investigate the effects of different types of internet use on changes in depression. This US based study carried out telephone surveys with 1,222 respondents of all ages in 2001 (85% completed one year follow-up). Results suggested that, after adjusting for depressive symptoms at baseline, gender, age, marital status (married/not), and ethnicity (white/non-white), internet use for communication purposes at Time 1 was associated with lower levels of depression at Time 2, while internet use for non-communication purposes at Time 1 was associated with higher levels of depression at Time 2. A similar finding was reported by Morgan and Cotten (2003) as they found a positive association between email and chatroom/IM use and lower depressive symptoms while, conversely, browsing online was associated

with higher depressive symptoms in their cross-sectional study of US undergraduates (n=287), after adjusting for age and gender. Notably, these studies use samples of participants of all ages and undergraduate students respectively so the extent to which findings apply to adolescent populations is unclear.

Findings such as these support the argument that moderate media use in general may be positively associated with adolescent mental health (Romer et al., 2013) and these findings from the Bessière et al. (2008) and Morgan and Cotten (2003) studies suggest that this may be the case for social media use in particular. However, neither the study by Bessière et al. (2008) nor the study by Morgan and Cotten (2003) accounted for the frequency of use or amount of time spent using social media. In addition, as these studies were carried out prior to the emergence of Facebook and prior to the rise in popularity of tablets, smartphones and mobile internet use which have greatly increased adolescents time online (Livingstone et al., 2014), their comparability and relevance to today's adolescents is questionable.

These findings from media effects research offer some theoretical and empirical insight into possible links between frequency of social media use and adolescent mental health. However, from a psychiatric epidemiology perspective, media effects research has a number of limitations. Conceptual models of associations between media use and its effects tend to be generalised across all potential health, behaviour, and social outcomes. For the purposes of this study, theories more explicitly focused on pathways between media use and mental health specifically must be considered. While media effects models such as the DSMM (Valkenburg & Peter, 2013) offer a useful conceptualisation of the way in which media use, individual characteristics and media effects might interact; media effects models, including the DSMM, fail to specify factors which might be particularly important, and fail to specifically conceptualise factors which might have a positive or negative effect. Finally, many different forms of media now converge online and it is therefore increasingly important to focus on specific platforms of contexts for use as effects of use may differ across different types of use (Brown & Bobkowski, 2011).

2.2.2.2 Social media use, social relationships, and adolescent mental health

From a psychiatric epidemiological perspective, as outlined in the introductory chapter to this thesis, it is posited that adolescent social relationships are directly associated with their mental health (Cohen et al., 2000). Whether or not social media

use has a positive or negative influence on adolescent social relationships is a topic of much theoretical debate. Researchers interested in CMC and its links to face-to-face communication have focused on the way in which social media use may directly influence social relationships, and in turn affect adolescent mental health. The central debate in this field exists between proponents of the *social stimulation hypothesis* (McKenna & Bargh, 2000) and the *social displacement hypothesis* (Kraut et al., 1998), and also from research comparing the way in which social media features may support or hamper social relationships. From a theoretical perspective, support for the *social stimulation hypothesis* suggests that social media use may positively impact adolescent social relationships, and in turn their mental health. Alternatively, support for the *social displacement hypothesis* suggests that social media use may have a negative influence on adolescent social relationships, and consequentially on their mental health based on the theorised direct links between social relationships and adolescent mental health.

In order to understand the rationale underpinning the *social stimulation hypothesis,* the importance of peer relationships during adolescence must be considered. During adolescence, individuals embark on a quest of self-development in which they aspire to achieve psychosocial autonomy and independence from their parents and to develop a stronger sense of individual and social identity through increased self-expression and self-presentation (Steinberg & Morris, 2001). On a social level, compared to children, adolescents also form more complex hierarchical social structures and become increasingly concerned with the way in which they are viewed by their peers (Blakemore, 2012). During adolescence, young people's friendships change significantly as more reciprocal and supportive relationships develop (De Goede, Branje, & Meeus, 2009). Their friendships become more intimate as they increasingly share their worries, secrets and ambitions (Burnett & Blakemore, 2009). During adolescence, parent-child relationships may often be strained and characterised by increased levels of conflict (Van Doorn, Branje, & Meeus, 2011). Researchers have highlighted that friendships with peers serve many purposes for adolescents including the development of social skills in the areas of perspective taking and empathy, intimacy and conflict resolution but also in areas related to psychological well-being such as social support (Desjarlais & Willoughby, 2010).

In support of a theoretically positive association between social media use and better adolescent social relationships, researchers interested in comparing CMC and face-to-face communication acknowledge the way in which several features of social media

platforms augment and complement this adolescent quest for psychosocial autonomy and peer connection (Valkenburg & Peter, 2011). Most notably, social media enable adolescents to have heightened levels of control over their self-presentation and social interactions. This control allows adolescents to communicate anonymously online but also allows adolescents to control and limit their self-presentation according to the richness of cues they portray via a combination of verbal, visual and audio information (Valkenburg & Peter, 2011). Adolescents can also control their online communication given the accessibility, immediacy, and asynchronous nature of social networking sites and instant messaging services. These features allow them to connect with their peers regardless of their physical location, to simultaneously and instantly transmit information about themselves across their wide network of friends and to take time to construct, edit and read over messages before they send them if desired. Thus, compared to face-to-face contact, users of social media have increased control over the way in which they present themselves to their peers (Valkenburg & Peter, 2011). In addition, there is research evidence to suggest that online communication facilitates enhanced self-disclosure among peers, therefore enriching social relationships by increasing intimacy (Lee et al., 2011; Valkenburg & Peter, 2009). As illustrated here, the features and functionality of social media are attractive to adolescents as they may be seen to parallel their motivations during this developmental stage. From this perspective, the *social stimulation hypothesis* posits that online communication may benefit offline social relationships and support adolescents' personal and social development, thus having a positive influence on their mental health.

Support for the *social stimulation hypothesis* includes findings from the cross-sectional Apaolaza et al. (2013) study which suggested that Spanish adolescents who reported more frequent use of the SNS "Tuenti" reported greater well-being and this association was mediated by decreased loneliness and increased self-esteem. In addition, Pierce (2009) found that those who reported not being comfortable with face-to-face communication reported a preference for, and higher levels of engagement in, online communication and texting. Also, in a cross-sectional USA-based study of 10 to 16 year olds (N=626), those who reported symptoms of social anxiety and loneliness or just loneliness were more likely to report higher levels of social media use (Bonetti et al., 2010) suggesting that communication via social media may fulfil adolescents needs for affiliation, at least to a certain degree.

However, researchers interested in comparing CMC and face-to-face communication have also emphasised the ways in which online and offline communication may not be interchangeable. Indeed, socialising online may be problematic, particularly for early adolescents whose brains and social cognitions may still be developing. The brain regions most heavily involved in social cognition – including regions of the parietal, prefrontal and superior temporal cortices – show the greatest change during adolescence (Choudhury, Blakemore, & Charman, 2006). This social cognitive development is thought to be the outcome of the simultaneous development of the self, increased autonomy in decision making, pubertal changes and the immersion in the socialisation processes inherent within the school environment. The anonymous and asynchronous communication afforded by social media may, therefore, be problematic for adolescents as socio-cognitive skills are still undergoing development. In addition, online communication and use of social networking sites may lead to greater levels of social comparison as others portray themselves online in a favourable way which may make their peers feel worse in comparison (Chou & Edge, 2012). Increased disclosure online may also lead adolescents to later regret revealing personal information (Suler, 2004).

In addition, proponents of the *social displacement hypothesis* argue that social media use may displace face-to-face socialising and time spent in other activities (Kraut et al., 1998) and as such online communication may be associated with poorer adolescent mental health. There is some empirical evidence to support the social displacement hypothesis. In their small-scale study of US undergraduates Kross et al. (2013) found that over a two-week period, increased Facebook use was associated with decreased life satisfaction and argued that this may have been related to increased social comparisons online. Kalpidou, Costin, and Morris (2011) also examined cross-sectional associations between Facebook use and well-being among undergraduates and found that spending a lot of time on Facebook was associated with lower levels of self-esteem.

Summarising the multidisciplinary research outlined in this section, there is evidence to suggest that moderate use of social media may have a positive influence on adolescent mental health. There is also corresponding evidence to suggest that heavy social media use or non-use of social media may be associated with poorer mental health outcomes. There is mixed evidence in terms of associations between social media use and social relationships. The *social stimulation hypothesis* suggests social media use may be associated with social benefits while the *social displacement hypothesis*

suggests that social media use may be associated with a reduction in the quality of social relationships. Assessing social media platforms separately – that is, examining SNS and IM separately – aims to examine the extent to which findings are consistent across different social media platforms, given that different platforms have distinct features and are characterised by different types of use. Therefore, based on the available evidence, the following two hypotheses have been identified:

> **Hypothesis 1:** It is hypothesised that very high and very low levels of SNS use at baseline will be associated with poorer mental health (in the form of greater risk of depressive symptoms and social anxiety symptoms, and poorer well-being scores) at follow-up.
>
> **Hypothesis 2:** It is hypothesised that very high and very low levels of IM use at baseline will be associated with poorer mental health (in the form of greater risk of depressive symptoms and social anxiety symptoms, and poorer well-being scores) at follow-up.

Overall, debate continues between proponents of the *social stimulation hypothesis* and supporters of the *social displacement hypothesis*. This has led to a surge in research which argues that it is the quality rather than the quantity of social media use which influences adolescent mental health (Oh et al., 2014). From this perspective, researchers interested in CMC compared to face-to-face communication and those researching the migration of offline behaviours into the online domain have begun to investigate the extent to which specific behaviours exhibited online by adolescents and the structure of adolescents' online social networks are associated with mental health outcomes. This study addresses these aspects of adolescents' social media use by specifically focusing on associations between cyberbullying involvement and adolescent mental health and by addressing two characteristics of adolescents' online network structure – the size of their SNS network (i.e. the number of friends they report having on their most used SNS) and whether or not they communicate with strangers online. Section 2.2.3 focuses on cyberbullying and its links to adolescent mental health while Section 2.2.4 focuses on associations between adolescents' online network structure and mental health.

2.2.3 Cyberbullying and adolescent mental health

Research examining the impact of cyberbullying on adolescent mental health has also stemmed from multiple disciplines. Notably, researchers interested in CMC

have examined the way in which communication in an online, screen-based domain may facilitate more negative peer interactions compared to face-to-face communication and how this has led to the emergence of cyberbullying. An alternative approach has been adopted by researchers focusing on traditional forms of bullying. Many researchers in this field have begun to examine the way in which traditional forms of bullying have migrated into the online domain and the extent to which bullying occurring online (cyberbullying) influences adolescent mental health. In this section, research from both of these perspectives is considered in order to shed light on this new phenomenon of cyberbullying and its potential links with adolescent mental health. In this section, the theoretical link between computer mediated communication (CMC) and cyberbullying proposed by CMC researchers is first addressed. Following this, existing empirical literature and debate as to associations between involvement in cyberbullying and adolescent mental health are described.

2.2.3.1 Cyberbullying definition, prevalence, and links to traditional bullying

In terms of online behaviour – cyberbullying is an increasing cause for concern among young people, parents, educators, and practitioners working with young people. In spite of progress made by large scale intervention policies designed to tackle high levels of bullying in schools, levels of bullying behaviour are still quite high (Livingstone, Haddon, Görzig, & Olafsson, 2011b). Traditional bullying is widely defined as "aggressive behaviour in which there is an imbalance of power favouring the perpetrator(s) who repeatedly seek to hurt or intimidate a targeted individual" (Rigby & Smith, 2011 pg. 442), and is of particular concern to parents, students, teachers and researchers given its impact long-term associations with poorer mental health outcomes (Arseneault, Bowes, & Shakoor, 2010; Bowes, Joinson, Wolke, & Lewis, 2015). In line with definitions of traditional bullying, cyberbullying may be understood as intentional, repeated harm of another which takes place via electronic communication tools (Mishna, Khoury-Kassabri, Gadalla, & Daciuk, 2012). The traditional conceptualisation of bullying has been challenged with the advance of social media and emergence of cyberbullying. Given the permanence of online messages and the ease with which other users can see and transmit content via social media, some researchers argue that the criteria of repetition, intention, and power imbalance which are important in traditional bullying may not apply directly to instances of cyberbullying (Dooley, Pyżalski, & Cross, 2009; Modecki, Barber, & Vernon, 2013; Runions, Shapka, Dooley, & Modecki, 2013).

Throughout this PhD, insofar as is possible, person-centred language will be used (i.e. person who cyberbullies instead of "cyberbully") but for brevity and ease of understanding there are times when labels such as "cybervictim" or "cyberbully" may be clearer, particularly when referring to analyses. In using such terms, no offence is intended nor should these terms be considered to suggest that such labels represent the primary characteristics of individual participants. Adolescents may be involved in cyberbullying in different ways. Some individuals are targeted by cyberbullying but do not engage in cyberbullying perpetration. For simplicity, these individuals are sometimes referred to in this PhD as "cybervictims". There are other individuals who perpetrate but are not targeted by cyberbullying and these individuals may be referred to as "cyberbullies". Finally, there are some individuals who both perpetrate and are targeted by cyberbullying and these individuals may be referred to as "cyberbully-victims".

Reviews of cyberbullying suggest that prevalence rates are generally estimated at between 10% and 35% depending on the population, definition and measurement used (Mishna et al., 2012). In the UK, findings of a cross-sectional study based in Northern Ireland by McGuckin, Cummins, and Lewis (2010) suggested that over 10% of adolescents (aged 11, n=7139) reported being involved in cyberbullying as cybervictims and 3.4% reported that they had cyberbullied others in the previous two months. In addition, another cross-sectional UK-based study of adolescents aged 11-16 (n=533), found that 10.4% of adolescents reported being victimised by cyberbullying in the previous week, month or term, while 9.3% reported perpetrating cyberbullying in the previous week, month or term (Smith et al., 2008). It is possible that these levels have increased given the rise of social media use in the past 7 years. Results of the NCGM study suggest that 21% of adolescents report being victimised by bullying which has remained stable since 2010. In 2010 most bullying took place offline whereas by 2013 the majority of individuals who reported being victimised indicated that bullying had taken place online (12%) suggesting bullying behaviours may be transferring into an online domain (Livingstone et al., 2014).

Though some researchers argue that cyberbullying is a new method of engaging in traditional bullying (Beran & Li, 2005), there is also a strong argument for recognising the way in which the emergence of cyberbullying brings with it new potential for risk in a constantly connected environment in which adolescents seamlessly interweave the cyber and real world (Spears, Slee, Owens, & Johnson,

2009). While there is some overlap between cyberbullying and traditional forms of bullying (Kowalski & Limber, 2013), the factors which predict traditional and cyberbullying are not the same (Perren, Dooley, Shaw, & Cross, 2010; Yang et al., 2013). In addition, cyberbullying has been found to be related to mental health independent of traditional bullying involvement. For example, cyberbullying involvement has been shown to be independently associated with depressive symptoms even after adjusting for traditional bullying involvement (Bonanno & Hymel, 2013). Results of a confirmatory factor analysis carried out in the USA suggested cyberbullying has been shown to represent a separate construct from overt and relational forms of victimisation (Dempsey, Sulkowski, & Nichols, 2009).

In relation to traditional bullying, bully-victims generally report the poorest levels of physical and psychological health and academic ability (Kowalski & Limber, 2013) but while bully-victims represent the smallest category in relation to traditional bullying, studies of cyberbullying suggest that this is a common group. For example, in their large scale cross-sectional study of adolescents in middle- and high-school in the US, Mishna et al. (2012) found that 23.8% of students reported being victims of cyberbullying in the previous 3 months, 8% reported being cyberbullies, and 25.7% reported being cyberbully-victims. These differences between cyberbullying and traditional bullying highlight the importance of conducting further research into the impact of cyberbullying involvement on adolescent mental health as findings related to traditional bullying may not be fully generalizable to a cyberbullying context.

2.2.3.2 Theoretical link between computer mediated communication and cyberbullying

Hinduja and Patchin (2007) highlighted three features of cyberbullying which theoretically may exacerbate its negative influence on adolescent mental health in comparison to traditional forms of bullying. First, online messages have a permanence compared with verbal statement which means that they can be reviewed afterwards or that they can be stored or further transmitted by others at any stage. Second, the ease at which hurtful acts can be carried out online and simultaneously transmitted to a wide audience which means that instances of cyberbullying may be witnessed by a lot more people than is usually the case for traditional forms of bullying. Lastly, a crucial issue is the way in which cyberbullying may be seen to transcend physical boundaries in place within society. Though once primarily confined to the school grounds, bullying now also occurs via digital technologies which can be accessed via desktop or mobile technologies in any location and as such may prevent young people from escaping it.

This introduces new complexities in terms of understanding its impact on young people (Mishna, Saini, & Solomon, 2009; Von Marees & Petermann, 2012). In addition, in terms of the role of the school and the parents in policing bullying, the digital nature of these behaviours also makes it more difficult to ascribe responsibility to specific authorities as cyberbullying moves beyond the boundaries of the school gates (Willard, 2007).

As discussed above, several features of social media augment and complement adolescents' quests for psychosocial autonomy and peer connection (Valkenburg & Peter, 2011) however, paralleling this, certain features of social media may also contribute to interpersonal problems and conflict among adolescents. Indeed, the anonymous and asynchronous communication afforded by social media may also be problematic for adolescents, as these features can lead to an "online disinhibition effect" (Suler, 2004). The "online disinhibition effect" is a term used to describe the way in which individuals tend to act in a less restrained manner online, for example, by disclosing more personal information, than they would offline or by acting more aggressively online than they would in their offline lives (Lapidot-Lefler & Barak, 2012). A number of theoretical reasons for this "online disinhibition effect" have been suggested. Notably, the way in which the screen enables users to control the richness of the social cues they provide when communicating with others online may lead to reduced concern for the judgement of others which in turn leads many adolescents to express themselves more openly online (Suler, 2004).

Research into traditional bullying has focused on investigating whether those who engage in traditional bullying or cyberbullying lack maturation in aspects of social cognition or if they are in fact skilled manipulators of their victims and some support has been found for both explanations (Sutton, Smith, & Swettenham, 1999). Specifically focusing on cyberbullying, it is argued that the reduction in social cues transmitted online may impair the adolescent's ability to feel empathic and engage in moral reasoning. According to Suler (2004), enhanced self-disclosure online resulting from reduced inhibitions can be a source of stress to adolescents who later feel exposed, vulnerable or ashamed of something intimate they have revealed, particularly if this disclosure opens them up to victimisation from their peers. Suler (2004) also posited that asynchronous communication via social media may interfere with the adolescent's ability to recognise the link between their behaviour and its consequences. Thus, adolescents may "loosen up" online and their normal behavioural restraints may be

ignored. As a result, when communicating online individuals may become disinhibited leading some to act more rudely, aggressively, angrily, harshly or threateningly towards their peers than they perhaps would in face-to-face communication.

From this perspective, the emergence of this online aggression or "cyberbullying" may be conceptually different from traditional bullying forms and although its links to traditional bullying and peer conflict may be considered, it is important to investigate this new phenomenon of cyberbullying in its own right, particularly in terms of associations with mental health given its prevalence, our limited understanding of this construct, and its links to mental health over time.

2.2.3.3 Cyberbullying and Adolescent Mental Health

Understanding the impact of cyberbullying is crucial if better means of detecting it, preventing it, and reducing its impact on adolescent mental health are to be identified. This is a particular priority for many researchers and policy makers given the links between cyberbullying and negative psychosocial outcomes (Valkenburg & Peter, 2011). A number of cross-sectional studies have identified a positive association between victimisation by cyberbullying and psychological distress (primarily depressive symptoms) among adolescents (Bonanno & Hymel, 2013; Healy & Lynch, 2013; Juvonen & Gross, 2008; Landstedt & Persson, 2014; Mitchell, Ybarra, & Finkelhor, 2007; Moore, Huebner, & Hills, 2012; Schneider, O'Donnell, Stueve, & Coulter, 2012; Ybarra, 2004; Ybarra, Mitchell, Wolak, & Finkelhor, 2006). Fewer studies have examined the impact of involvement in cyberbullying as a cyberbully on adolescent mental health. Findings in relation to associations between perpetration of cyberbullying and adolescent mental health are also less homogenous. Cross-sectionally, some studies have suggested that perpetration of cyberbullying is associated with higher levels of depressive symptoms, symptoms of anxiety, stress, lower levels of life-satisfaction and rule-breaking behaviour (Bonanno & Hymel, 2013; Campbell, Slee, Spears, Butler, & Kift, 2013; Moore et al., 2012; Ybarra, Diener-West, & Leaf, 2007). However, results of some cross-sectional studies suggest that associations between cyberbullying involvement and poorer adolescent mental health are only significant for cybervictims and not for perpetrators of cyberbullying (Baker & Tanrikulu, 2010; Perren et al., 2010).

The aforementioned studies have examined cyberbullying involvement exclusively in terms of cybervictimisation or in terms of perpetration of cyberbullying and have overlooked the cyberbully-victim group. Conceptualisation of cyberbullying involvement which included an examination of the cyberbully-victim group is

uncommon in the cyberbullying literature. This is surprising, particularly when traditional bully-victims have been shown to be the most vulnerable in terms of mental health outcomes (Pellegrini, 1998). For physical, verbal and relational forms of bullying, victims and bully-victims have been found to have significantly higher depression scores than bullies. In addition, students who were both traditional and online bully-victims have been suggested to be most at risk for poor adjustment in the form of high scores in aggression, depression, and somatic symptoms (Gradinger, Strohmeier, & Spiel, 2009). However, recent cross-sectional research by Wang, Nansel, and Iannotti (2011) (mean age=14.2, N=7313) suggests that this is not the case for cyberbully-victims, after adjusting for gender, ethnicity, family affluence, and school year, while cybervictims report higher scores of depression than bullies.

All of the studies focusing on associations between involvement in cyberbullying and adolescent mental health discussed up to this point have been cross-sectional. Studies examining the longitudinal impact of involvement in cyberbullying have only just begun to emerge (Livingstone & Smith, 2014). One recent study by Gamez-Guadix, Orue, Smith, and Calvete (2013) found evidence for a reciprocal relationship between victimisation by cyberbullying and depressive symptoms among adolescents. Using path analysis in their study of Spanish adolescents (n=845), the authors found that involvement in cyberbullying as a victim at baseline was associated with depressive symptoms 6 months later and also that higher depressive symptoms at baseline were associated with victimisation by cyberbullying 6 months later. Only cybervictimisation, depression, and substance use at Time 1 and Time 2 were included in these path analyses and so this study is limited as no other variables, including gender in particular, have been adjusted for in these models. This study also explored whether cyberbully-victims and cybervictims differed in terms of their reported mental health and univariable analyses suggested that, within the baseline cross-section, compared to being a cybervictim only, being a cyberbully-victim was associated with higher levels of depression. These unadjusted findings are in contrast to the adjusted findings reported by Wang et al. (2011) in suggesting that cyberbully-victims do indeed have poorer mental health outcomes than those who are cybervictims only.

In contrast to these findings regarding longitudinal associations between cybervictimisation and adolescent mental health, Machmutow, Perren, Sticca, and Alsaker (2012) found an association between cybervictimisation at Time 1 and depressive symptoms at 6 months later but this association was not sustained after

adjustment for baseline depressive symptoms. This suggests that the association between cyberbullying involvement at baseline and depressive symptoms at follow-up may have been accounted for by the participants' baseline depressive symptoms in this study. It is possible that those who were already exhibiting depressive symptoms at baseline in the Machmutow et al. (2012) study may have been more likely to be victimised by cyberbullying. Notably however, this study did not have a very large sample size and models were adjusted for several other factors (including traditional bullying involvement, cyberbullying involvement at follow-up, gender, age, and coping style) so there may have been little power to detect an effect after additionally adjusting for baseline depressive symptoms.

In addition, Bannink, Broeren, van de Looij-Jansen, de Waart, and Raat (2014) conducted a large-scale (n=3181) longitudinal study (2 year follow-up) looking at cyber- and traditional victimisation (but not perpetration) in the Netherlands. Notably, this study had a very low retention rate across waves (38%). Results of this study suggested that being a victim of cyberbullying was not related to mental health problems (as measured using the Strengths and Difficulties Questionnaire (Goodman, 1997)) among males whereas among females, those who reported cyberbullying victimisation were one and a half times as likely to report mental health problems at follow-up after controlling for baseline mental health. This suggests that gender may play an important role in associations between involvement in cyberbullying and adolescent mental health, an issue which will be discussed in detail in Section 2.3.1.2.

To the best of my knowledge, there are currently no UK-based studies examining the longitudinal association of cyberbullying involvement with adolescent mental health, and very few longitudinal studies exist internationally. Longitudinal research is needed in order to begin to establish whether causal associations exist between involvement in cyberbullying and adolescent mental health. The results of this study will provide much needed evidence as to the longitudinal associations between involvement in cyberbullying as a cyberbully-victim and adolescent mental health outcomes. This is important as this group has been given little attention in the cyberbullying literature and the limited findings to date have not been consistent. This study controls for baseline mental health which strengthens the evidence for a causal pathway between cyberbullying and adolescent mental health as associations sustained after adjustment for baseline mental health provide stronger evidence for temporality in the association between cyberbullying and future mental health.

Theoretically, as outlined above, it is plausible that adolescent involvement in cyberbullying as a cyberbully, a cybervictim, or as a cyberbully-victim may be associated with poorer mental health. The third hypothesis for this study has been based on the literature outlined in this section.

> **Hypothesis 3:** It is hypothesised that involvement in cyberbullying at baseline (as a cybervictim, cyberbully or cyberbully-victim) will be associated with poorer mental health (in the form of greater odds of reporting depressive symptoms and social anxiety symptoms, and greater risk of below average well-being) at follow-up.

While cyberbullying may represent one means of identifying the quality of adolescents' online relationships, the structure of adolescents' online networks in terms of their online network size and online communication with strangers, may also influence the quality of social relationships and adolescent mental health. The theoretical and empirical underpinnings for this are discussed in the following section.

2.2.4 Online network structure and adolescent mental health

Communication via social media may be broadly categorised according to three different categories of friendship: first, adolescents may use social media to communicate with those within their close network of friends and family; second, social media may function as a means of keeping in touch with those from more distal, weak-tie relationships; and third, social media may be used as a method of communicating with strangers. It is posited that the mental health outcomes of social media use may differ depending on the type of friendships that adolescents maintain via their online networks (Reich, Subrahmanyam, & Espinoza, 2012). Research examining the impact of adolescents' online network structures has also been approached from multiple conceptual backgrounds. First, focusing on the size of adolescents' online networks, researchers interested in CMC have examined the extent to which online "friends" and the size of adolescents' networks online may be representative of their overall social network size and the social support available to them. Secondly, media effects and CMC researchers have become interested in adolescents' communication partners online and the extent to which young people communicate with strangers via social media. An alternative approach has been taken by researchers interested in adolescent risk-taking behaviour generally and these researchers have investigated the extent to which online communication with strangers is an example of such risky adolescent behaviour (Dowell, Burgess, & Cavanaugh, 2009) and its corresponding association

with mental health outcomes. This section addresses both aspects of adolescents' online network structure. Current information relating to adolescent network size is provided along with existing theoretical and empirical evidence linking online network size to adolescent mental health. The prevalence of communication with strangers among adolescents and its associations with mental health outcomes are also examined.

2.2.4.1 Size of adolescent SNS networks: Links to mental health

Results of the Net Children Go Mobile (NCGM) Study (Livingstone et al., 2014) suggest that in the UK, 33% of 9-16 year olds report having contact with over 100 people via SNS and 17% report communicating with strangers online (Livingstone et al., 2014). However, becoming "friends" with another individual via SNS is extremely simple and no maintenance is required in order to keep that friendship active. Previous research has stemmed from two theoretical rationales in relation to the way in which SNS network size and adolescent health might be linked. It is argued that the size of an adolescent's SNS network may impact upon their mental health either via the social support garnered from the number of contacts in that network or, alternatively, via the way in which the size of that network impacts upon an adolescent's identity formation and sense of self.

The first of these two pathways is based on the hypothesis that there is a relationship between SNS network size and an adolescent's real-world network of social support. SNS represent a cheap and easy means of keeping in touch with close friends and family and also with large, diffuse networks of weak social ties (Donath & Boyd, 2004). There is a growing body of evidence to suggest that Facebook use among emerging adults (aged 18 to 25) is associated with increases in both bonding social capital (which emphasises the emotional benefit of having strong family and friendship ties) and bridging social capital (which emphasises the benefits of having a heterogeneous network of weak ties for information purposes) over a one year period (Steinfield, Ellison, & Lampe, 2008). Social capital is considered an important component of adolescent psychosocial development (Sullivan, 1953) and there is convincing evidence within the literature to signify a protective effect of social support on mental health (Stansfeld, 2005). Therefore, as a result of the social support associated with having a large network of SNS ties; it is plausible that larger social networks may lead to mental health improvements over time for adolescents. There is some support for this hypothesis in the existing cross-sectional literature. For example, Nabi, Prestin, and So (2013b) conducted a cross-sectional study of US undergraduate

students and found, using path modelling, that number of Facebook friends (but no other measure of Facebook use) was associated with higher levels of perceived social support which was associated in turn with reduced stress, lower levels of physical illness and higher levels of psychological well-being. In addition, Oh et al. (2014) also used path modelling and found a positive cross-sectional association between number of SNS friends, perceived social support and life satisfaction. However, while the affordances of SNS may offer new means of developing and maintaining relationships easily, it is not yet clear whether the size of early adolescents' social networks online is representative of their actual networks of social support, particularly, as the research to date has been carried out primarily with undergraduate student populations.

The second pathway from SNS network size to adolescent mental health stems from the assumption that larger numbers of SNS contacts impacts upon an adolescent's identity or sense of self which in turn affects their mental health. Previous research has argued that adolescents develop their identity through their SNS use as they use their profiles to portray the aspects of themselves of which they are most proud (Manago, Graham, Greenfield, & Salimkhan, 2008). This self-presentation online may impact positively upon their mental health if they perceive their SNS content is being viewed by a larger audience of friends within their network (Ahn, 2011; Manago, Taylor, & Greenfield, 2012). Greenfield's Theory of Social Change and Human Development (Greenfield, 2009) suggests that immersion in social media technologies promotes individualistic characteristics such as narcissistic traits, an orientation toward popularity, and large networks of weak ties with strangers or superficial contacts rather than close, intimate friendships. In a small-scale study of US undergraduates, Manago et al. (2012) tested this theory by focusing on the development of intimacy and social support in relation to the characteristics of emerging adults' (age 18-25) SNS profiles. The authors found that superficial relationships formed the majority of the social network and that these weak-tie relationships increased disproportionately as the SNS network size expanded. However, rather than a lack of intimacy, the authors found that instead, online status updates were primarily used for self-disclosure (a key component of intimacy), transforming what was once a characteristically private, more intimate, exchange between close friends into what is now a more public performance.

In contrast to this, however, it is also plausible that the larger the network of friends an adolescent has on SNS, the greater their exposure to the positive self-presentation of their online friends, which may lead to increased levels of upwards

social comparison (Blomfield Neira & Barber, 2014). Chou and Edge (2012) found that adolescents who spend more time online report feeling that their friends online are happier or have better lives than them which may impact negatively on their mental health. It is not clear from the previous literature whether having very large networks of friends can also lead to this increase in social comparison. It is possible that very large networks of SNS contacts are based on weak tie relationships and may not represent a tangible source of social support (Kim & Lee, 2011). Indeed, in their study of undergraduates, Kim and Lee (2011) found a negative curvilinear relationship between number of Facebook friends and perceived social support which suggests that Facebook may serve as a source of social support but only up to a point that users can devote sufficient time to maintaining close relationships with friends. This has not yet been explored in early adolescent populations or in studies with a longitudinal design.

Theoretically, assuming adolescents' online networks are representative of their available social support, it is plausible that the size of adolescents' SNS networks may have a positive impact on adolescent mental health. Large networks may also increase adolescents' sense of audience which may positively influence adolescents in terms of exploring identity and intimacy online. The fourth hypothesis for this study is based on this theoretical rationale:

> **Hypothesis 4:** It is hypothesised that those who have very high numbers of friends online at baseline will report better mental health (in the form of lower odds of depressive symptoms and social anxiety symptoms, and lower risk of below average well-being) at follow-up compared to those with average sized networks of online friends.

2.2.4.2 Communication with strangers online: Links to mental health

There is evidence to suggest that online communication with strangers is relatively common among early adolescents. For example, findings from the NCGM study suggest that a proportion of adolescents communicate with strangers online with 10% of 11-12 year olds and 25% of 13-14 year olds reporting that they have had contact on the internet in the past 12 months with someone they had never met face-to-face (Livingstone et al., 2014). In addition, in their survey of Dutch adolescents (n=412) Peter et al. (2006) found that early adolescents (12-14 year olds) were most prone to online communication with strangers compared with older adolescents, after adjusting for gender.

There has been limited exploration of the mental health impact of communicating with strangers online. Bessière et al. (2008) conducted a longitudinal US survey from 2001 to 2002 (N=1012, 85% over 19 years of age) to explore the impact of different types of internet use on depressive symptoms. Results of this study suggested that internet use for communication was associated with increased depressive symptoms only when the communication was with individuals not known in the real world and not when it was with family or friends. Similarly, Valkenburg and Peter (2007b) found that communication online was positively associated with perceived closeness of friendships, but not for those who communicate with strangers online.

There are two conceivable pathways by which communication with strangers online may be linked to adolescent mental health. Firstly, online communication with strangers may be a sign that the adolescent is engaging in higher levels of risk-taking behaviour generally. Dowell et al. (2009) suggested that there is a clustering of online risk behaviour among some early adolescents. In this study (n=404), communication with strangers online was associated with other online risk taking behaviour including posting personal photos online, posting personal information online (e.g. name of school), and perpetrating cyberbullying or online harassment. Similarly, in their study of Flemish adolescents, Vandoninck, D'Haenens, De Cock, and Donoso (2011) found that those who communicate with strangers online were more likely to publish personal information online, to meet in person with someone met online, and to engage in aggressive online activities such as cyberbullying. Thus, there is some evidence to suggest that online communication with strangers is one example of adolescent risk-taking behaviour which occurs in an online domain and as such may be potentially considered an example of maladaptive risk-taking during adolescence.

Secondly, it is theoretically plausible that communication with strangers online may be a sign of psychosocial developmental issues in relation to friendship formation which lead certain adolescents to seek fulfilment of their affiliation needs online (Peter et al., 2006). Indeed, Wolak, Finkelhor, and Mitchell (2008) conducted a cross-sectional study of US adolescents (aged 10-17) and found that participants most at risk when communicating with strangers include those with existing mental health or social problems and those who exhibit other rule-breaking behaviours. In addition, Ybarra, Alexander, and Mitchell (2005) found that communication with strangers online was more common in young people who reported depressive symptoms in their US based study (n=1501). Whether communicating with strangers is linked to future incidence of

mental health problems requires further investigation as the limited previous longitudinal research was conducted prior to the advent of Facebook and other popular SNS.

Recent recommendations highlight the importance of going beyond exploring risks involved in social media use to now explore the harm caused by these risks (Livingstone & Smith, 2014). While previous studies have focused on the prevalence of communication with strangers online, few studies have examined this potential risk factor for poorer adolescent mental health. Based on the theoretical rationale outlined here, the fifth hypothesis was developed for this study:

> **Hypothesis 5:** It is hypothesised that those who report communicating with strangers online at baseline will report with poorer mental health (in the form of greater risk of depressive symptoms and social anxiety symptoms, and poorer well-being scores) at follow-up.

2.2.5 Summary: Associations between Characteristics of Social Media Use and Adolescent Mental Health

The primary research question asks – how is the mental health of adolescents associated with their social media use? Throughout this section of the literature review, the aim has been to highlight the approach taken to answering this question within this study and to describe the theoretical and empirical foundations upon which this study has been built. Specifically, the approach taken in this study involves examining "social media use" in terms of the following characteristics: frequency of use of specific social media platforms (SNS and IM), cyberbullying involvement, and the structure of adolescents' online networks (in terms of network size and communication with strangers). Five hypotheses have been identified which are tested in this study in order to establish the extent to which each of these characteristics of social media use at baseline is associated with mental health outcomes in the form of depressive symptoms, social anxiety symptoms, and mental well-being specifically, at follow-up one year later in a sample of early adolescents in the UK.

Based on this literature review, however, individual factors which may influence associations between social media use and adolescent mental health have been identified. The following section focuses on the theoretical and empirical rationale for exploring the potential moderators in associations between the characteristics of social media use and adolescent mental health.

2.3 Role of Individual Factors in Associations between Social Media Use and Adolescent Mental Health

Two secondary research questions have been identified for exploration in this study: first, how might the pathways from characteristics of social media use to adolescent mental health differ for males and females? And second, what role might peers and parents play in buffering or exacerbating the impact of the characteristics of adolescents' social media use on their mental health? In this section, the role of gender is first addressed followed by a focus on the potential influence of peer and family factors in associations between the characteristics of social media use (frequency of SNS/IM use, cyberbullying involvement, and online network structure) and adolescent mental health outcomes.

2.3.1 Gender

Gender differences in the impact of social media use on adolescent health may be argued from two perspectives. On one hand, symptoms of mental health problems are more common among females and so it is possible that males and females may respond differently when exposed to the same stressor. Gender differences in reports of mental illness are well established in the literature. For example, findings of the East London based RELACHS study (Stansfeld et al., 2003) indicated that in Year 9 (aged 13-14), 16.4% of males and 32.9% of females reported depressive symptoms (measured as scores of eight or more on the Short Moods and Feelings Questionnaire (Angold, Costello, Messer, & Pickles, 1995)). In exploring reasons for gender differences in depressive symptoms, Kawachi and Berkman (2001) argued that higher prevalence of psychological distress among females may be attributable to gender differences in social support derived from network participation. This is rationalised by the theory that females maintain more emotionally intimate relationships, rely on more social supports during time of stress, and provide more frequent and effective support than males. As a result, it is theorised that females are predisposed to the "contagion of stress" and as such suffer more from other people's problems than males (Kawachi & Berkman, 2001). Similarly, Hamilton, Stange, Abramson, and Alloy (2014) found that females tend to have greater exposure to interpersonal dependent stressors (i.e. stressful events which are in some way *dependent* on social behaviour or characteristics including, for example, fights with friends or family, end of romantic relationships) which in turn contribute to their heightened levels of rumination and in turn depressive symptoms compared to males.

On the other hand, it is also plausible that the factors causing depression or symptoms of other mental illnesses may be different for males and females. In line with this, gender differences in predictors of mental health have been observed in previous research. For example, Schraedley, Gotlib, and Hayward (1999) found that social factors such as stress and social support may show stronger associations with depressive symptoms females than males.

2.3.1.1 Gender differences in associations between social media use and adolescent mental health

Previous research has suggested that the function of online communication is different for males and females. For example, Bonetti et al. (2010) found that females communicate with same-sex friends and family more than males and are more motivated to use online communication to maintain friendships. In contrast, Bonetti et al. (2010) found that males reported communicating online more about videogames, online games and sports than females and males were more motivated to communicate with strangers online than females. In addition, Dowell et al. (2009) found that females preferred online communication while males preferred directly socialising with peers, and Pierce (2009) found that females reported feeling less comfortable with face-to-face communication and more comfortable with texting or social networking sites than males. Although gender was not found to moderate the negative association between Facebook use and well-being in the study by Kross et al. (2013), this study had little power to detect such a moderating effect given the small sample size (n=82).

Perhaps surprising then are the findings of the NCGM study (Livingstone et al., 2014) which suggest that 65% of males and 50% of females aged 9-16 years reported having a SNS profile, suggesting greater use of SNS amongst boys. However, while a higher proportion of males reported having a profile on an SNS, there is evidence from the NCGM study to support the proposition that the function of SNS may differ for males and females. In the NCGM study, a higher proportion of females reported that they talk about private things on the internet (27%) and find it easier to be themselves online (44%) compared to males (16%, and 33% respectively). These differences in usage patterns and motivations suggested by the NCGM study (Livingstone et al., 2014) may represent one way in which frequency of social networking site or instant messaging use may show different associations with mental health and well-being for males and females. Theoretically, the increased propensity for females to talk about more private, intimate issues online may increase their exposure to interpersonal

dependent stressors compared to males (e.g. their peers' stresses, conflict within the peer group), and may increase levels of co-rumination which may lead to poorer mental health outcomes among females as theorised in the Hamilton et al. (2014) study.

Hypotheses 6a and 6b have been based on the theoretical rationale outlined in this section which suggests that females' motivations for online communication and the content of their online interactions may increase their exposure to interpersonal stressors and their levels of co-rumination in comparison to males. Based on this it was anticipated that the association between frequency of SNS or IM use and reports of poorer adolescent mental health outcomes would be stronger among females.

> **Hypothesis 6a:** It is hypothesised that the relationship between use of social networking sites at baseline and mental health outcomes (depressive symptoms, social anxiety and positive well-being) at follow-up will be moderated by gender and that the association will be stronger for females.

> **Hypothesis 6b:** It is hypothesised that the relationship between use of instant messaging at baseline and mental health outcomes (depressive symptoms, social anxiety and positive well-being) at follow-up will be moderated by gender and that the association will be stronger for females.

2.3.1.2 Gender differences in associations between cyberbullying involvement and adolescent mental health

Gender differences in cyberbullying involvement have been notably inconsistent across studies (Livingstone & Smith, 2014; Tokunaga, 2010). Some research has suggested that males are more likely to be involved in cyberbullying as cyberbullies while females are more likely to be involved as cybervictims (Dempsey et al., 2009; Elgar et al., 2014; Pouwelse, Bolman, Lodewijkx, & Spaa, 2011; Sengupta & Chaudhuri, 2011). However, there are also studies which have found no gender differences in cyberbullying involvement (Fletcher et al., 2014; Landstedt & Persson, 2014; Smith et al., 2008). Inconsistent findings in terms of gender differences in reported involvement in cyberbullying may be a feature of the time frame or frequency of cyberbullying incidents investigated. Ybarra and Mitchell (2007) found that females were 50% more likely than males to be low-frequency perpetrators of cyberbullying whereas males were three times as likely as females to be frequent perpetrators of

cyberbullying which suggests that the frequency of cyberbullying may offer some explanation as to the variation in reported gender differences. As such, gender differences may depend on the frequency of cyberbullying being examined.

Rose and Rudolph (2006) argued that the tendency of females to express emotions in response to stress more than males and to co-ruminate with their peers may increase intimacy in female relationships and mean that females are less likely to engage in anti-social behaviour. These processes may also place females at higher risk of emotional difficulties than males. Based on this theoretical rationale, it is theorised that exposure to interpersonal stress in the form of cyberbullying may have a more negative influence on internalising mental health outcomes for females. There is some support for this argument in the literature. Bannink et al. (2014) found that being a victim of cyberbullying was not related to mental health problems among males but was associated with increased mental health problems, after controlling for baseline mental health in females. There is limited research on gender interactions in associations between cyberbullying involvement and mental health, however. Where gender is included, it is most frequently considered as a covariate in analyses rather than exploring its moderating role in such associations.

In contrast, research on traditional bullying has suggested that males may experience more negative mental health outcomes in response to bullying than their female peers. In a large, multi-ethnic study of adolescents in East London, Rothon, Head, Klineberg, and Stansfeld (2011) reported an interaction between gender and involvement in traditional forms of bullying in terms of associations with mental health, whereby being bullied had a strong impact on the odds of reporting depressive symptoms in males only. It was theorised that this may be attributable to an increased tendency for females to seek help and offer support and comfort to their victimised peers. The extent to which females share experiences of cyberbullying or seek help in response to being victimised by cyberbullying is unknown.

It is important to move toward exploring conditional effects in terms of links between involvement in cyberbullying and adolescent mental health rather than focusing exclusively on main effects. Based on theory suggesting that online co-rumination is more common among females and may therefore have a more negative influence on the mental health of females involved in cyberbullying than males, hypothesis 6c was developed:

Hypothesis 6c: It is hypothesised that the relationship between involvement in cyberbullying (as a cybervictim, cyberbully or cyberbully-victim) at baseline and mental health outcomes (depressive symptoms, social anxiety and positive well-being) at follow-up will be moderated by gender and that this relationship will be stronger for females.

2.3.1.3 Gender differences in associations between online network structures and adolescent mental health

There is some research evidence to suggest that males and females may have different online network structures and it is posited that these differences in network structures may lead to gender differences in associations between online network structures and adolescent mental health. Previous research has suggested that reported size of SNS networks and communication with strangers online differs between females and males. Results of the Net Children Go Mobile Study (Livingstone et al., 2014) suggest that 44% of males had over 100 contacts on their SNS profile compared to 22% of females suggesting there may be significant gender differences in size of friendship networks on SNS. In addition, there is also previous research which suggests that using SNS to communicate with strangers is more common among males (Vandoninck et al., 2011). Findings of the NCGM study suggest that a greater proportion of males report having a public SNS profile that anyone can see (22%) than females (15%). Within the same survey, 19% of males reported having contact with a stranger online in the past 12 months compared to 15% of females.

As previously mentioned, it is plausible that large networks of friends may increase upwards social comparisons among adolescents (Blomfield Neira & Barber, 2014; Chou & Edge, 2012). Given the aforementioned research suggesting that females may be more likely to engage in rumination than males (Rose & Rudolph, 2006) it is plausible that large networks of friends may be more strongly associated with upwards social comparisons with others among females which may have a negative influence on the mental health of females compared to males. In addition, there is research evidence to suggest that females place a stronger emphasis on intimate relationships than males (Rose & Rudolph, 2006) but large online networks may be more strongly associated with weak-tie relationships. As such it is theoretically plausible that females with large online networks may struggle to maintain their more intimate relationships. For females with very large online networks, the maintenance of their large network may come at

the expense of intimate relationships which may lead to poorer mental health outcomes. Support for this theory stems from research by van den Eijnden et al. (2008) who argued that online relationships with weak-ties (e.g. strangers or acquaintances) may be more strongly associated depressive symptoms than online contact within more intimate relationships. This argument therefore extends to online communication with strangers as such weak-tie relationships may be more strongly associated with poor mental health outcomes for females than males based on the same theory.

To the best of my knowledge, this is the first study investigating gender differences in associations between online network structure and adolescent mental health. Based on the theoretical rationale outlined above, the following two hypotheses have been identified:

> **Hypothesis 6d:** It is hypothesised that the relationship between online network size and mental health outcomes (depressive symptoms, social anxiety and positive well-being) will be different for males and females, with larger online networks associated with poorer mental health outcomes for females.
>
> **Hypothesis 6e:** It is hypothesised that the relationship between communication with strangers at baseline and poorer mental health outcomes (depressive symptoms, social anxiety and well-being) at follow-up will be stronger for females.

2.3.2 Perceived Social Support and Parental Monitoring

In line with the conceptual framework adopted for the current study, there is considerable evidence as to the mental health benefits associated with social support (Stansfeld, 2005). Reports of low perceptions of social support from family or peers have been associated with increased depressive symptoms in a multi-ethnic cohort of adolescents in East London (Klineberg et al., 2006). Developmentally, adolescents tend to place a great deal of importance on their peer relationships (Steinberg & Morris, 2001) and a perception of high levels of social support from peers has been associated with better adolescent mental health, for example in the form of lower levels of depressive symptoms (Colarossi & Eccles, 2003).

In addition, the links between parenting characteristics and child outcomes has been explored and theorised in a number of ways within the literature but two critical constructs have emerged. The first, ‘support’, refers to characteristics such as

attachment, love, and acceptance while the second, 'control', refers to characteristics such as monitoring and discipline (Barnes & Farrell, 1992). Perceived parental social support has been associated with better adolescent mental health (Rothon, Goodwin, & Stansfeld, 2012). Low levels of parental monitoring have also been associated with poorer mental health (Repetti, Taylor, & Seeman, 2002). The roles of both perceived social support from parents and family and parental monitoring have begun to be examined within the literature relating to associations between characteristics of social media use and adolescent mental health and this will be explored throughout this section.

2.3.2.1 Role of peers/parents in associations between social media use and adolescent mental health

Current literature on associations between social media use and mental health also suggests a need for further investigation into the potential moderating role of perceived social support. From a media effects research perspective, in line with the *Differential Susceptibility to Media Effects Model* (Valkenburg & Peter, 2013), it is posited that social factors may both predict media use and act as a moderator of the relationship between media use and media effects. Extending this theory to mental health research suggests that social factors – perceived social support from peers and family in this case – may both act as a predictor of social media use and also act as a moderator in associations between social media use and adolescent mental health.

Some studies conceptualise social support as a mediator in associations between social media use and adolescent mental health. Apaolaza et al. (2013) found that the positive association between social networking site use and well-being (measured as life satisfaction) was mediated by loneliness. That is, SNS use was associated with reduced loneliness which in turn was associated with increased adolescent well-being. In addition, using structural equation modelling, Sarriera, Abs, Casas, and Bedin (2012) found evidence to suggest that using technology for communication purposes is positively associated with perceived social support from peers but negatively associated with perceived social support from family in their study of Brazilian adolescents aged 12-16. The findings of this study suggest that use of technology for communication purposes has an indirect influence on adolescent well-being via perceived peer support. These studies offer evidence to suggest the importance of perceived social support. However, while these studies suggest a mediating effect of perceived social support,

there may be a more solid theoretical foundation for the hypothesised moderating effect of perceived social support.

There is some evidence to suggest a moderating role of perceived peer support in associations between adolescent social media use and mental health. For example, Selfhout, Branje, Delsing, ter Bogt, and Meeus (2009) tested whether perceived friendship quality moderated longitudinal associations between online communication and symptoms of depression and social anxiety in their Netherlands-based study of 14 to 17 year olds (N= 307). Results of this study offered support for the *Social Compensation Hypothesis* (Campbell, Cumming, & Hughes, 2006) which suggests that social media use may be most beneficial for those with poorer quality social relationships. In the study by Selfhout et al. (2009) online communication was associated with lower depressive symptoms one year later only for those with low perceived friendship quality at baseline. However, other studies have suggested more support for the *Rich-get-richer hypothesis* which posits that online communication will be most beneficial to those who already have high quality social relationships (Kraut et al., 2002). For example, Lee (2009) found that adolescents who already had strong social relationships at earlier ages were more likely to use social media and to also report more cohesive friendships later in adolescence.

There is evidence to suggest that young people are consistent in their social behaviours across different contexts, including their offline and online (Mikami, Szwedo, Allen, Evans, & Hare, 2010). Indeed, in their small scale study, Mikami et al. (2010) found that adolescents' peer relationships, friendship quality, and behavioural adjustment at age 13-14 predicted the quality of their online interactions and psychological adjustment at age 20-22. These findings suggest that social support may modify the association between SNS and IM use and adolescent mental health. There may be support for the *rich-get-richer hypothesis* as adolescents who have good offline social relationships may benefit from nurturing those social relationships online but also for the corresponding *poor-get-poorer* hypothesis which suggests that those who have poor quality offline relationships experience the most negative outcomes from social media use (Kraut et al., 2002).

The role of family and parenting characteristics in associations between media use and adolescent mental health has received little attention in the literature to date. Szwedo, Mikami, and Allen (2012) focused specifically on mother-adolescent

relationships and found that low quality mother-adolescent relationships were associated with adolescent preferences for online communication but also fewer friends posting positive messages on adolescents' SNS. Szwedo et al. (2012) argued that negative mother-adolescent interactions may lead the adolescent to expect negative interactions which may lead them to act in less intimate ways, even when online. Alternatively, it may be that adolescents go on to replicate online the negative interactions or low-support relationships modelled in the home. Extending these findings to the wider family, it may be that adolescents who have low levels of perceived social support from family may engage in high frequency social media use and may also be involved in less intimate, less supportive online relationships which may more negatively influence their mental health compared to their peers with higher levels of perceived social support from their families.

There is some evidence to suggest that low levels of parental monitoring may be associated with internet addiction among adolescents (Yen, Ko, Yen, Chang, & Cheng, 2009). This suggests that adolescents who are not monitored by their parents may be more likely than their monitored peers to spend excessive time online though whether those poorly monitored adolescents show stronger associations between frequency of social media use and poorer mental health outcomes than their more closely monitored peers is still unknown. The potentially protective role of social support from family in associations between use of IM/SNS and adolescent mental health merits further exploration. Hypotheses 7a and 7b have been based on the theorised moderating role of perceived social support of peers and family and of parental monitoring in associations between social media use and adolescent mental health.

> **Hypothesis 7a:** It is hypothesised that the association between non-use or very high levels of SNS use at baseline and poorer mental health outcomes at follow-up will be stronger for those who report low levels of peer or family support and those who report low levels of parental monitoring.

> **Hypothesis 7b:** It is hypothesised that the association between non-use or very high levels of IM use at baseline and poorer mental health outcomes at follow-up will be stronger for those who report low levels of peer or family support and those who report low levels of parental monitoring.

2.3.2.2 Role of peers/parents in associations between cyberbullying involvement and adolescent mental health

Perceptions of support received from parents and peers may also play an important role in modifying the impact of involvement in cyberbullying on adolescent mental health. The importance of the role played by social support in traditional bullying has been emphasised, though findings have been complex. Some studies have shown that low social support can lead to more negative mental health outcomes for adolescents victimised by traditional forms of bullying (Rigby, 2000). Another study has suggested that perceived social support may protect adolescents from becoming involved in traditional forms of bullying but that perceived social support from peers may not protect those adolescents who are already bullied from negative mental health outcomes (Rothon et al., 2011). Extending this traditional bullying literature to the exploration of the role of social support in cyberbullying may lead to a greater understanding of protective factors which may in turn act as a buffer in the relationship between cyberbullying and adolescent mental health.

Holt and Espelage (2007) studied 784 middle and high school students in USA. Results of multivariable analyses carried out for this study indicated a significant interaction between bully/victim groups and perceived peer support. Specifically, those uninvolved in cyberbullying reported lowest levels of anxiety/depression and their levels of anxiety/depression were similar across all levels of perceived social support. In contrast, those involved in cyberbullying as cyberbullies, cybervictims, or cyberbully-victims reported higher levels of anxiety/depression. For cybervictims and cyberbully-victims, those who reported high levels of perceived peer support reported highest levels of anxiety/depression while for cyberbullies, those with low peer support reported highest levels of anxiety/depression. These findings point towards a moderating role of perceived social support in associations between cyberbullying involvement and adolescent mental health. Similarly, Machmutow et al. (2012) found a moderating effect of perceived social support in associations between victimisation by cyberbullying and increased depressive symptoms at follow-up which were stronger for those with low social support suggesting a buffering role of social support from friends in this association. Further examination of the role of peer support in longitudinal associations between involvement in cyberbullying (i.e. for cyberbullies, cybervictims, and cyberbully-victims) and mental health is needed.

Low levels of parental monitoring have been associated with increased risk-taking behaviour and adjustment problems in adolescents (Dishion & McMahon, 1998). Indeed, poor relationships with parents and low levels of parental monitoring have been associated with a higher risk for young people to be involved in traditional bullying and cyberbullying either as a bully or as a victim (Ybarra & Mitchell, 2004). Low levels of parental monitoring have also been associated with higher levels of victimisation by cyberbullying (Ybarra et al., 2007). In relation to perceived support, Holt and Espelage (2007) found that those with higher maternal social support reported lower levels of anxiety and depression. In addition, Fanti, Demetriou, and Hawa (2012) found that perceived social support from family was a protective factor related to decreases in cyberbullying perpetration at one year follow-up among Cypriot adolescents. In addition, parental monitoring was identified as a possible buffer against the negative mental health effects of traditional bullying victimisation (Jantzer, Haffner, Parzer, Resch, & Kaess, 2015). Very little research has examined the potentially buffering role of perceived social support in associations between involvement in any form of bullying and adolescent mental health (Holt & Espelage, 2007), a gap which merits further scrutiny in the cyberbullying literature. Hypothesis 7c, below, has been formed based on the theory outlined here suggesting a buffering roles of perceived social support from peers and parental monitoring.

> **Hypothesis 7c:** It is hypothesised that the association between involvement in cyberbullying at baseline and poorer mental health outcomes at follow-up will be stronger for those who report low levels of peer or family support and those who report low levels of parental monitoring.

2.3.2.3 Role of peers/parents in associations between communication networks and adolescent mental health

It has been theorised that adolescents with larger online networks will report better mental health outcomes than their peers with smaller networks on SNS because the size of adolescents' online networks is likely to be representative of their available social support. Where adolescents report having low levels of social support, it is plausible that large online networks are not representative of tangible social support and, in turn, large networks may be associated with poorer mental health outcomes for adolescents with low levels of perceived social support.

Kim and Lee (2011) found a negative curvilinear association between number of Facebook friends and perceived social support. The authors argued that making friends in the real world takes time and a lot of effort but becoming "friends" online is easy. It is plausible that, reports of large online networks by those with low levels of perceived peer support may be indicative of adolescents who have expanded their networks without putting effort towards making those social relationships grow and as such these "friends" may be a group of passive spectators on the adolescents' SNS rather than a group representing the adolescents' available social support.

In addition, the aforementioned study by Szwedo et al. (2012) suggested that poor quality mother-adolescent relationships were associated with adolescent preferences for high frequency online communication but also with low frequency posts written by friends on the adolescents' SNS. Therefore, those with low quality family relationships (measured in terms of perceived support from family and parental monitoring in this study) may receive very few posts on their SNS from friends, even if they report having a large network on friends online and this may lead to poorer mental health outcomes compared to their peers with high levels of perceived social support. These findings offer some support for the theory that perceptions of peer relationships and family may play an important role in associations between online communication networks and adolescent mental health.

In terms of communication with strangers online, again, the role of perceived support may be important. Bessière et al. (2008) found that using the internet to communicate with strangers online was associated with higher depression scores for those with high or medium social support but not associated with increases in depression for those with low perceived social support. In this study, perceived social support was not separated out by source so overall perceptions are reported rather than reporting separate perceptions of peer and family support. These results suggest that individual differences in social resources may play some role in accounting for different mental health outcomes reported in the empirical literature and this should be further explored in future research.

Using SNS to communicate with strangers is more common among those with poor relationships with their parents (Vandoninck et al., 2011). In turn, low levels of parental monitoring have been associated with increased adolescent risk-taking both offline and online (Orpinas, Murray, & Kelder, 1999; Pujazon-Zazik & Park, 2010).

Thus, characteristics of parents and families may increase the likelihood that adolescents will communicate with strangers online. There is also evidence to suggest that children and adolescents in family environments characterised by conflict or by poor relationships with parents are at increased risk for mental health disorders across the life span (Repetti et al., 2002). In addition, parents have been identified as a vital resource in promoting adolescent resilience against substance use, violent behaviour, sexual behaviour and other risk during adolescents (Fergus & Zimmerman, 2005). It is therefore plausible that parents may also promote adolescent resilience against negative mental health outcomes associated with communication online with strangers. Based on the rationale outlined here, the following two final hypotheses for this study were identified.

> **Hypothesis 7d:** It is hypothesised that having very high numbers of friends online at baseline will be associated with poorer mental health at follow-up for those with low perceived peer or family support and those who report low levels of parental monitoring.
>
> **Hypothesis 7e:** It is hypothesised that the association between communicating online with strangers at baseline and poorer mental health at follow-up will be stronger for those with low perceived peer or family support and those who report low levels of parental monitoring.

2.3.3 Summary: Role of Individual Factors in Associations between Social Media Use and Adolescent Mental Health

In summary, though there is considerable theoretical rationale to suggest that individual and social factors including gender and peer/family factors may impact associations between social media use and adolescent mental health, there is little existing empirical research exploring these conditional effects. This study aims to add to the literature on this topic to enhance our understanding of the potentially moderating role of gender, perceived peer and family support, and parental monitoring in associations between social media use and adolescent mental health. Such findings may offer valuable insight into potential factors which may buffer adolescents against negative mental health outcomes associated with the characteristics of their social media. In turn, such factors may represent viable pathways which could be targeted in interventions to improve adolescent mental health.

2.4 Methodological Considerations

This PhD study builds upon the foundations of previous research on the relationship between the characteristics of social media use and adolescent mental health. This study aims to build on existing research by addressing some of the methodological limitations inherent in existing research on this topic. As outlined below, the key methodological strengths of this study include the longitudinal nature which enabled adjustment for baseline mental health; the UK-based study setting; the focus on early adolescence; the strength of the evidence attributable to the large sample size and adjustment for key confounders; the selection and measurement of social media characteristics; and the selection of mental health outcomes and measures. Each of these methodological aspects of this study is addressed below in reference to previous work in this field.

2.4.1 Longitudinal research

To date, the majority of studies focusing on links between social media use and adolescent mental health have been cross-sectional and so limit our ability to make any inferences about the existence of causal pathways between social media use and adolescent mental health and our ability to examine whether associations are sustained over time. With reference to studies focusing on the frequency of social media use and adolescent mental health the studies by Apaolaza et al. (2013), Kalpidou et al. (2011), Lee et al. (2011), Morgan and Cotten (2003), and Pierce (2009) all relied on cross-sectional data and the study by Kross et al. (2013) used a follow-up period of just two weeks. In addition, longitudinal cyberbullying research is very much in its infancy with very few papers on this topic (Bannink et al., 2014; Gamez-Guadix et al., 2013; Machmutow et al., 2012), none of which have included information on cybervictims, cyberbullies, and cyberbully-victims. Research on links between online network structure and adolescent mental health has all been cross-sectional to date. The limited longitudinal data on this topic emphasises a gap in the literature. Most studies have been unable to take baseline mental health into account and so it is unclear whether associations between characteristics of adolescents' social media use and mental health outcomes are accounted for by adolescents' existing mental health. The need to fill this gap is predicated on the need to identify modifiable risk and protective factors for adolescent mental health with a view to improving mental health across the lifespan. The longitudinal data emerging from this study, along with adjustment for baseline mental health, aims to strengthen the evidence for a causal association between characteristics of social media use and adolescent mental health.

2.4.2 UK-based research evidence

In terms of designing public health interventions to improve adolescent mental health in the UK, it is vital that we collect local UK data to examine the potential role of adolescent social media use in shaping adolescent mental health. However, most existing research on this topic has been carried out in other countries. Though prevalence studies indicate that UK adolescents report some of the highest usage figures in Europe and involvement in cyberbullying in the UK is estimated at greater than 1 in 10, there is very little research to date in the UK which investigates the generalisability of international research findings on this topic to a UK sample. For example, research examining associations between social media use and mental health have been conducted outside the UK. This study provides local UK data specific to a cohort of adolescents living in areas of East London characterised by high levels of deprivation.

In terms of associations between frequency of social media use and adolescent mental health, most studies have been based on populations in the USA (Bessière et al., 2008; Kalpidou et al., 2011; Kross et al., 2013; Morgan & Cotten, 2003), the Netherlands (Valkenburg, Peter, & Schouten, 2006), Spain (Apaolaza et al., 2013), and South Korea (Lee et al., 2011). Though researchers in the UK have begun to explore the prevalence of cyberbullying (Livingstone et al., 2014; Smith et al., 2008), few studies in the UK have examined associations between cyberbullying involvement and adolescent mental health (Fletcher et al., 2014). In addition, while some studies have explored the characteristics of online network structures among adolescents (Livingstone & Haddon, 2009) this represents the first UK-based study to examine associations between online network characteristics and adolescent mental health.

Longitudinal UK-based research on this topic will be of direct benefit to policy makers in areas of public health and education. In addition, findings may be useful in the development of intervention policies to tackle cyberbullying prevalence rates in schools and interventions designed to promote adolescent mental health and well-being. No previous study has combined literature on the different characteristics of social media into one study to explore the mental health impact. In exploring use of social media (IM and SNS specifically), cyberbullying involvement, and adolescents' online network structure (size of SNS network, communication with strangers), this study aims to draw together these often distinct fields of research and explore them within the same study from a psychiatric epidemiological perspective with the aim of identifying social

media-related factors which may be particularly important in predicting mental health outcomes in adolescents.

2.4.3 Focusing on early adolescents

To date, while some studies have focused on the frequency of social media use among teenage populations (Apaolaza et al., 2013), most previous research has been on older adolescent or undergraduate college student populations (Kalpidou et al., 2011; Kross et al., 2013; Lee et al., 2011; Romer et al., 2013; Schiffrin, Edelman, Falkenstern, & Stewart, 2010) or adults (Bessière et al., 2008). Early adolescence is a critical period in the development of internalising symptoms (Andersen & Teicher, 2008; Costello et al., 2005; Steinberg, 2005) and as such it is important to focus on this age group specifically with a view to identifying risk and protective factors for adolescent mental health during this phase. This study focuses exclusively on early adolescence with a view to addressing this gap in the literature.

2.4.4 Strength of the evidence

This study builds upon previous research by focusing on a large sample of participants. Many existing studies on this topic have focused on small samples, with studies of frequency of social media use often including fewer than 100 participants including the aforementioned studies by Kross et al. (2013) and Kalpidou et al. (2011). In adopting a psychiatric epidemiology approach this study is able to provide estimates of effect sizes in relation to associations between the characteristics of social media use and adolescent mental health. The majority of previous studies have focused on identifying group differences in mental health outcomes based on adolescent social media use though there has been a much lower focus on the magnitude of these differences – information which is particularly important in considering, designing, and testing the efficacy of interventions designed to improve adolescent mental health. The larger sample size and the epidemiological approach to analyses also enable adjustment for multiple confounding factors which strengthens our ability to estimate the influence of the social media variables over and above other key variables (e.g. gender, SES, ethnicity) known to be important factors in the prediction of mental health.

2.4.5 Multi-faceted conceptualisation of the characteristics of adolescent social media use

It is important that media effects research is rooted in theory and that research findings are used to further develop theories which focus on associations between social media use and mental health specifically. This PhD aims to build upon existing literature by investigating the mental health outcomes of adolescent social media use in

terms of associations between i) SNS/IM use ii) cyberbullying involvement, and iii) online communication networks. In terms of social media use specifically, Selfhout et al. (2009) found no evidence to suggest that internet use in general is good or bad overall but instead suggested that the context in which internet use occurs needs to be taken into account. It is vital that researchers in the UK keep abreast of changes in adolescent use of social media given that social media use has become such a prominent socialising influence on young people. Valkenburg and Peter (2007a) emphasise the importance of differentiating between online communication technologies as there is a risk of finding misleading null-effects when use of different platforms are combined within a study (Valkenburg & Peter, 2007a) and this study aims to address this by focusing separately on SNS and IM use, and on characteristics of social media use other than frequency including involvement in cyberbullying, and the characteristics of adolescents' online networks such as online network size and online communication with strangers.

2.4.6 Conceptualising adolescent mental health – mental illness and mental well-being

In terms of mental health it is important to consider both mental illness and mental well-being. To the best of my knowledge, none of the studies examining associations between the characteristics of social media use and adolescent mental health included both measures of mental illness and measures of mental well-being, despite the fact that these represent two distinct (though related) constructs (Westerhof & Keyes, 2010). A better understanding of the way in which the use of social media is associated with adolescent mental health and well-being may be helpful in the design and evaluation of interventions which aim to improve adolescent mental health.

2.5 Integrative Framework

This literature review has focused on the characteristics of adolescents' social media use in the form of SNS use, IM use, cyberbullying involvement, and their network structure including network size and communication with strangers online. As outlined in this literature review, current theories related to the potential mechanisms by which the characteristics of social media use may influence adolescent mental health are rooted in the way in which social media may both nurture and challenge social relationships during adolescence and in turn influence adolescent mental health outcomes. Integrating the main theories outlined in this literature together suggests that these theories may be best categorised into four main themes:

i. **Online and offline relationships are similar and interdependent in terms of influence on adolescent mental health:** This theme refers to theorised mechanisms which place an emphasis on the ways in which online relationships are similar to, and complement, offline relationships. Based on such theory, greater levels of integration into online social networks may positively influence adolescent relationships and mental health outcomes, while greater levels of peer conflict experienced using social media may negatively influence adolescent relationships and mental health outcomes.

   Theories related to this theme include *the social stimulation hypothesis* (McKenna & Bargh, 2000) which suggests that social media enhance offline relationships, theories focusing on how non-use of social media may be indicative of an adolescent who is removed from the social group (Bélanger et al., 2011), theories which suggest that online peer conflict and bullying may detrimentally influence adolescent mental health similar to traditional forms of bullying (Gradinger et al., 2009; Kowalski & Limber, 2013), and theories which suggest that the size of online networks may reflect the amount of social support available to the adolescent (Nabi, Prestin, & So, 2013a; Oh et al., 2014).

ii. **Online disinhibition effects:** There is a growing body of theoretical and empirical literature to suggest that the reduction in social cues in an online setting which may foster greater levels of online disinhibition and lead adolescents to act more harshly in online compared to face-to-face settings (Suler, 2004). This reduction in social cues is believed to be

particularly problematic for early adolescents as neural areas related to social cognition skills undergo a period of critical development throughout adolescence (Blakemore, 2012). Social cognition skills including empathy and perspective taking may be additionally challenged in settings lacking non-verbal social cues such as facial expressions and cues related to tone which are not as easy to convey via text-based social media (Suler, 2004).

iii. **Online communication is different from face-to-face communication:** This theme relates to theorised mechanisms which focus on features of online communication which distinguish it from face-to-face communication with a potentially detrimental impact on adolescent mental health. Broadly, the *social displacement hypothesis* (Kraut et al., 1998) suggests that online communication displaces time which could be spent doing other activities, including time which could be spent in face-to-face communication. More specific features of social media theorised to influence adolescent mental health outcomes include the permanence of online messages, the lack of geographical or time-related boundaries which means cyberbullying and other aspects of social media use can follow adolescents home from school and reach them in their homes any time of the day or night, and issues related to large and often unknown audiences in an online setting so a private communication can easily be transmitted either instantly or in the future (Aboujaoude, Savage, Starcevic, & Salame, 2015; Gamez-Guadix et al., 2013; Hinduja & Patchin, 2007; Selkie, Fales, & Moreno, 2016; Suler, 2004).

iv. **Type of relationships nurtured online:** This theme focuses on theoretical mechanisms which posit that adolescent mental health may be differentially influenced based on the type of relationship adolescents maintain online (Reich et al., 2012). Online settings tend to afford a greater focus and reliance on weak-tie relationships rather than more intimate dyadic bonds (Donath & Boyd, 2004; Greenfield, 2009; Manago et al., 2012). It is theorised that this may be particularly detrimental to the mental health of early adolescents from whom increased intimacy in close tie relationships is often more developmentally salient (Bukowski, Hoza, & Boivin, 1993). It is theorised that weak-tie relationships such as those characterised by online communication between strangers may be a

sign of psychosocial difficulties in friendship formation which may lead to adolescents attempting to fulfil needs for affiliation with strangers in online settings (Peter et al., 2006).

These four theoretical mechanisms underpin the hypotheses which have been developed for this PhD. The research questions and hypotheses are listed in the next section.

2.6 Research Questions and Hypotheses

The following research questions and hypotheses have been outlined within this literature review and are summarised here to provide a clear framework as to the structure of the study and the proposed analyses.

2.6.1 RESEARCH QUESTION 1:

HOW IS THE MENTAL HEALTH OF ADOLESCENTS IMPACTED BY THE CHARACTERISTICS OF THEIR SOCIAL MEDIA USE?

A) <u>Amount of time spent using social media</u>

Hypothesis 1: It is hypothesised that very high and very low levels of SNS use at baseline will be associated with poorer mental health (in the form of greater odds of depressive symptoms and social anxiety symptoms, and increased risk of below average well-being) at follow-up.

Hypothesis 2: It is hypothesised that very high and very low levels of IM use at baseline will be associated with poorer mental health (in the form of greater odds of depressive symptoms and social anxiety symptoms, and increased risk of below average well-being) at follow-up.

B) <u>Behaviour online</u>

Hypothesis 3: It is hypothesised that involvement in cyberbullying at baseline (as a cybervictim, cyberbully or cyberbully-victim) will be associated with poorer mental health (in the form of greater odds of depressive symptoms and social anxiety symptoms, and increased risk of below average well-being) at follow-up.

C) <u>Communication networks</u>

Hypothesis 4: It is hypothesised that those who have very high numbers of friends online at baseline will report better mental health (in the form of lower odds of depressive symptoms and social anxiety symptoms, and lower risk of below average well-being) at follow-up compared to those with average sized networks of online friends.

Hypothesis 5: It is hypothesised that those who report communicating with strangers online at baseline will report with poorer mental health (in the form of greater odds of depressive symptoms and social anxiety symptoms, and increased risk of below average well-being) at follow-up.

2.6.2 RESEARCH QUESTION 2:

HOW MIGHT THE PATHWAYS FROM CHARACTERISTICS OF SOCIAL MEDIA USE TO ADOLESCENT MENTAL HEALTH DIFFER FOR MALES AND FEMALES?

A) <u>Amount of time spent using social media</u>

Hypothesis 6a: It is hypothesised that the relationship between use of social networking sites at baseline and mental health outcomes (depressive symptoms, social anxiety and positive well-being) at follow-up will be moderated by gender with higher frequency SNS use associated with more negative mental health outcomes for females.

Hypothesis 6b: It is hypothesised that the relationship between use of instant messaging at baseline and mental health outcomes (depressive symptoms, social anxiety and positive well-being) at follow-up will be moderated by gender with higher frequency IM use associated with more negative mental health outcomes for females.

B) <u>Behaviour online</u>

Hypothesis 6c: It is hypothesised that the relationship between involvement in cyberbullying (as a victim, bully or bully-victim) at baseline and mental health outcomes (depressive symptoms, social anxiety and positive well-being) at follow-up will be moderated by

gender with involvement in cyberbullying associated with more negative mental health outcomes for females.

C) Communication networks

Hypothesis 6d: It is hypothesised that the relationship between online network size and mental health outcomes (depressive symptoms, social anxiety and positive well-being) will be different for males and females, with larger online networks associated with poorer mental health outcomes for females.

Hypothesis 6e: It is hypothesised that the relationship between communication with strangers at baseline and mental health outcomes (depressive symptoms, social anxiety and positive well-being) at follow-up will be different for males and females with online communication with strangers associated with more negative mental health outcomes for females.

2.6.3 RESEARCH QUESTION 3:

WHAT ROLE MIGHT PEERS AND PARENTS PLAY IN BUFFERING OR EXACERBATING THE IMPACT OF THE CHARACTERISTICS OF ADOLESCENTS' SOCIAL MEDIA USE ON THEIR MENTAL HEALTH?

A) Amount of time spent using social media

Hypothesis 7a: It is hypothesised that the association between non-use or very high levels of SNS use at baseline and poorer mental health outcomes at follow-up will be stronger for those who report low levels of peer or family support and those who report low levels of parental monitoring.

Hypothesis 7b: It is hypothesised that the association between non-use or very high levels of IM use at baseline and poorer mental health outcomes at follow-up will be stronger for those who report low levels of peer or family support and those who report low levels of parental monitoring.

B) Behaviour online

Hypothesis 7c: It is hypothesised that the association between involvement in cyberbullying at baseline and poorer mental health outcomes at follow-up will be stronger for those who report low

levels of peer or family support and those who report low levels of parental monitoring.

C) <u>Communication networks</u>

Hypothesis 7d: It is hypothesised that having very high numbers of friends online at baseline will be associated with poorer mental health at follow-up for those with low perceived peer or family support and those who report low levels of parental monitoring.

Hypothesis 7e: It is hypothesised that the association between communicating online with strangers at baseline and poorer mental health at follow-up will be stronger for those with low perceived peer or family support and those who report low levels of parental monitoring.

CHAPTER THREE

METHOD

3 CHAPTER THREE: METHOD

3.1 Study Design

This quantitative PhD study is nested within the Olympic Regeneration in East London (ORiEL) study. The ORiEL study is a longitudinal controlled quasi-experimental study evaluating the impact of urban regeneration associated with the London 2012 Olympic Games on a cohort of young people and their families in East London (Smith et al., 2012). The ORiEL study is funded by the National Institute for Health Research (NIHR). Data was collected from students across 25 schools in the boroughs of Newham (n=6), Tower Hamlets (n=7), Hackney (n=6) and Barking & Dagenham (n=6). Adolescent participants completed paper-based surveys in school settings at three time points. The first wave of data was collected in 2012 when the students were in Year 7 (aged 11-12), and then Wave 2 (2013) and Wave 3 (2014) were collected when adolescents were in Year 8 (aged 12-13) and Year 9 (aged 13-14) respectively. This PhD study investigates the longitudinal associations between social networking site (SNS) and instant messaging (IM) use, cyberbullying involvement, and online communication networks (i.e. size of SNS network, communication with strangers) and adolescent mental health (depressive symptoms, social anxiety symptoms, and mental well-being). Social media items were included at Wave 2 (2013) and Wave 3 (2014) of the ORiEL study only. The PhD analyses are therefore based on the data I collected as part of the ORiEL team at Wave 2 (Jan-July 2013) and Wave 3 (Jan-July 2014) of the ORiEL study, when the students were 12-13 years of age, and 13-14 years of age, respectively. For the purposes of this PhD thesis, Wave 2 will be referred to as **baseline** and Wave 3 as **follow-up** from this point onwards.

3.2 Participants

3.2.1 School and adolescent recruitment

Only state schools were included in the study; private schools, pupil referral units and schools for adolescents with special needs were excluded. In total, there were 48 eligible schools across the four study boroughs of Newham (15 schools), Hackney (11 schools), Tower Hamlets (15 schools) and Barking & Dagenham (9 schools). Schools were selected using simple randomisation within each borough with refusals replaced by eligible schools from the same borough. Where a school refused to participate, another school within the same borough was then randomly selected and approached. In total, letters were sent to the head teachers at 41 (85.4%) of the 48 eligible schools between 6th October 2011 and 23rd May 2012. Twenty five schools

agreed to participate (61.0% of those approached). Schools that refused participation cited a number of reasons, including most commonly "research fatigue" whereby schools feel that they have been over-approached to participate in research. Other reasons for refusal included time constraints and policies against research participation. Schools refusing did not differ from participating schools in terms of size, school type, catchment area or ethnic and religious composition. Participating schools were given a grant of £1000 in recognition of their contribution to the study.

Year 7 students in participating study schools were eligible to take part in the study at Wave 1 (2012). We aimed to recruit 100 students from each school at Wave 1 and to retain a minimum cohort of 74 of these students across the three study waves based on our sample size calculations. In seven schools this required that all Year 7 classes take part in the study while teachers at the other 18 schools, with larger enrolment numbers, selected a number of classes from the year group to participate. In instances where the school selected a number of classes (rather than having the whole year group participate) the lead contact teacher at that school selected participating classes based on timetabling: classes of mixed ability were requested by the research team. Any additional students subsequently enrolled in the classes that had participated at earlier waves of data collection were eligible for inclusion at subsequent waves, thus expanding the cohort.

Adolescent eligibility to participate was governed by a three stage process. First, head teachers were required to give active consent for the school to participate in the study, next passive parental consent was obtained from parents of students in participating classes and finally, active written assent was obtained from participating adolescents. Parents were given an information sheet about the study one week prior to the survey sessions and an opt-out form which they could return to the school if they did not wish for their son(s)/daughter(s) to take part. Adolescents opted-out of the study by their parents were given an alternative task during the survey sessions. Adolescents were also required to actively assent to participating in the study after being given a verbal explanation of purpose and design of the study, before beginning the questionnaire at each wave. The ORiEL study protocol has been published and provides further details on the design of the wider project (Smith et al., 2012).

3.2.2 Sample size

3.2.2.1 Power calculations

The sample size for this PhD is governed by the ORiEL study which is powered to identify differences in measures of parental employment, adolescent and parental mental wellbeing and adolescent and parental physical activity associated with urban regeneration related to the London 2012 Olympic Games. Based on previous research, a plausible conservative minimum change in these primary outcomes (employment, mental well-being, and physical activity) would be 8%. Under this assumption, a total sample size of 1766 adolescents (24 schools, min. 74 per school) would be required at Wave 3 to detect a difference of 8% in primary outcomes with 80% power at a significance level of 5%. There was limited information in the literature as to the effect sizes expected for associations between social media characteristics and mental health outcomes. The sample size here is larger than many existing studies, and uses validated measures, and as such was deemed large enough to detect effects of the main exposure variables. Where sample size was reduced, the subsequent limitations arising due to reduced power are acknowledged. Post hoc power calculations were carried out, however, for reference. For this study there were five main exposure variables and three main outcome variables. In terms of outcome variables, the majority of existing research in relation to associations between social media use and adolescent mental health has focused on mental health outcomes in the form of depressive symptoms. Therefore, power calculations specific to depressive symptoms have been carried out. In terms of depressive symptoms, using the SMFQ, a previous study of a similar population (the RELACHS study) estimated prevalence of depressive symptoms using the same cut-off as this study at 25% for similar aged participants (Stansfeld et al., 2003). All of the power calculations were carried out using an alpha level of 0.05 and power of 0.8.

In terms of social media use, results of the NCGM study estimated daily use of SNS and IM at 40%. With limited longitudinal research on this topic it was difficult to estimate an anticipated effect size in terms of the expected increase in odds of reporting depressive symptoms among those using SNS or IM at other frequencies. However, the study by Bélanger et al. (2011) suggested that compared to regular internet users, their peers reported a 31% to 86% increase in odds of reporting depressive symptoms. This study was cross-sectional and as such the lower estimate of 31% may be more applicable in a longitudinal setting. Power calculations based on these estimates suggested a required sample size of at least 1096 participants.

Estimates of cyberbullying prevalence vary between 10%and 35% depending on the population, definition, and measurement, used (Mishna et al., 2012). Given that involvement in cyberbullying was measured over a 12 month period in the current study it was estimated that the rate of cyberbullying would be in the higher range with approximately 30% expected to be involved in cyberbullying in some way. Few studies have estimated effect sizes for associations between cyberbullying and adolescent mental health but a review of cross-sectional studies examining associations between cyberbullying involvement and adolescent mental health by Bottino, Bottino, Regina, Correia, and Ribeiro (2015) suggested a twofold to fourfold increase in odds of internalising difficulties among those involved in cyberbullying compared to uninvolved peers. Focusing specifically on studies using the SMFQ, Rothon et al. (2011) found a 42% increase in odds of reporting depressive symptoms among victims of traditional bullying in the RELACHS cohort of adolescents with similar characteristics to the ORiEL study. This smaller increase of 42% has been used in power calculations as it was deemed more conservative, was based on the same measure of depressive symptoms, was based on a similar population, and was based on longitudinal data. Power calculations based on these estimates suggest the need for a sample of 782 participants.

In terms of network size, the NCGM study findings (Livingstone et al., 2014) suggested that 65% of participants reported having up to 100 friends on their most used social networking site. Estimates of effect sizes for association between network size and depressive symptoms were not available in the existing literature. However, as network size was theorised as a proxy for the adolescents available social support, it was anticipated that effect sizes would be similar to those observed for associations between perceived social support and depressive symptoms. In the RELACHS study of a similar population, the prospective association between social support and depressive symptoms suggested a twofold increase in odds of reporting depressive symptoms among those with low levels of social support (Khatib, Bhui, & Stansfeld, 2013). Friendship size may not fully parallel social support but the confidence interval runs from 1.4 to 3.5 in the Khatib et al. (2013) study which suggests a conservative estimate of a 40% increase in odds of depressive symptoms for those with lower support. Perhaps then, those with higher levels of social support may experience a reduction in odds of reporting depressive symptoms of a similar magnitude. Therefore, power calculations were carried out for a 40% reduction in odds among those with larger

network sizes and these power calculations indicated a minimum required sample size of 538.

Finally, based on the NCGM findings (Livingstone et al., 2014), it was anticipated that approximately 25% of participants would communicate with strangers online. The results of the cross-sectional Ybarra et al. (2005) study suggested a twofold increase in odds of depressive symptoms among females who talked to strangers online and a fourfold increase among males. However, it is important to note that these estimates are based on data collected prior to the rise in popularity of social media and are based on cross-sectional data. There was little available data regarding effect sizes for associations between communication online with strangers and depressive symptoms. Relative to estimates for the other exposures a twofold increase was deemed a large effect size for the power calculations. For the other exposures, the smallest effect size expected was a 30% increase in odds and so this estimate has been used to estimate required sample size to examine associations between communication with strangers and depressive symptoms in the absence of a more reliable estimate. Power calculations using an estimated 30% increase in odds of reporting depressive symptoms among those who communicated with strangers online indicated a minimum required sample size of 1497 participants.

The post hoc power calculations described in this section suggest that the study was sufficiently power to detect unadjusted main effects in relation to depressive symptoms for each of the exposures of interest.

3.2.2.2 Obtained sample size

Figure 1 illustrates participation in the ORiEL study across the three waves. As can be seen in the diagram, of the 3575 adolescents approached to participate at Wave 1, a sample of 3105 students took part and usable data was obtained for 3088 students (86.4%). Non-compliance by 17 students meant that, at Wave 1, 17 scripts were removed from analyses as the participants had not completed the questionnaire properly. This was recorded on the day by the fieldwork team where students informed the research team that they had not filled in the questionnaire honestly (a rare occurrence attributable to students rushing to finish the questionnaire in order to get to another school-based activity) or where the fieldwork team observed the student filling in the questionnaire and ticking responses without reading the questions. Reasons for non-participation included absenteeism (8.0%), parental opt-out (3.2%), student opt-out (0.6%), and conflicting school-based activity or inadequate English language

comprehension to complete the survey (1.3%). The Wave 2 sample comprised 3,213 students with usable data, including 2,700 (87.4%) of the original cohort. The Wave 3 sample comprised 3089 students with usable data. A final cohort of N=2254 was obtained which represented 73.0% of the original study members who completed all three surveys and were eligible for analysis. This PhD focuses only on those students present at both Wave 2 (PhD baseline) and Wave 3 (PhD follow-up) – a sample of 2646 participants (82.0% of the Wave 2 participants also completed Wave 3).

3.2.2.3 Exclusion criteria

A number of exclusion criteria were used to form the final analytic sample. Firstly, any adolescent respondent who had a record for 'non-compliance' in the data file – where the student was a random box ticker or where the questionnaire was not being taken seriously as the participant would not follow the instructions of the research team – was removed from the database. The study team was alerted to this during data collection and data cleaning, according to a protocol established in collaboration with the ORiEL study principal investigators to ensure consistency in data cleaning across study waves. Participants were also removed from analysis if they could not complete the survey because of their English language comprehension. In some cases the contact teacher informed the study team that a participant did not have the English language skills needed to take part in the survey session and in some cases this was brought to the fieldwork team's attention by the individual themselves. In addition, for the purposes of these analyses, participants were excluded if they did not provide details of their ethnicity, if they were missing all of the social media or mental health data at both baseline and follow-up, or if they moved school between Wave 2 and Wave 3. These latter three exclusion criteria were necessary for the multiple imputation and will be discussed below. As illustrated in Figure 1, following the exclusion of n=166 (6.3%) individuals based on these criteria, this resulted in a final cohort of 2480 participants for this PhD study (representing 77.2% of the full Wave 2 sample).

3.2.2.4 Participation flowchart

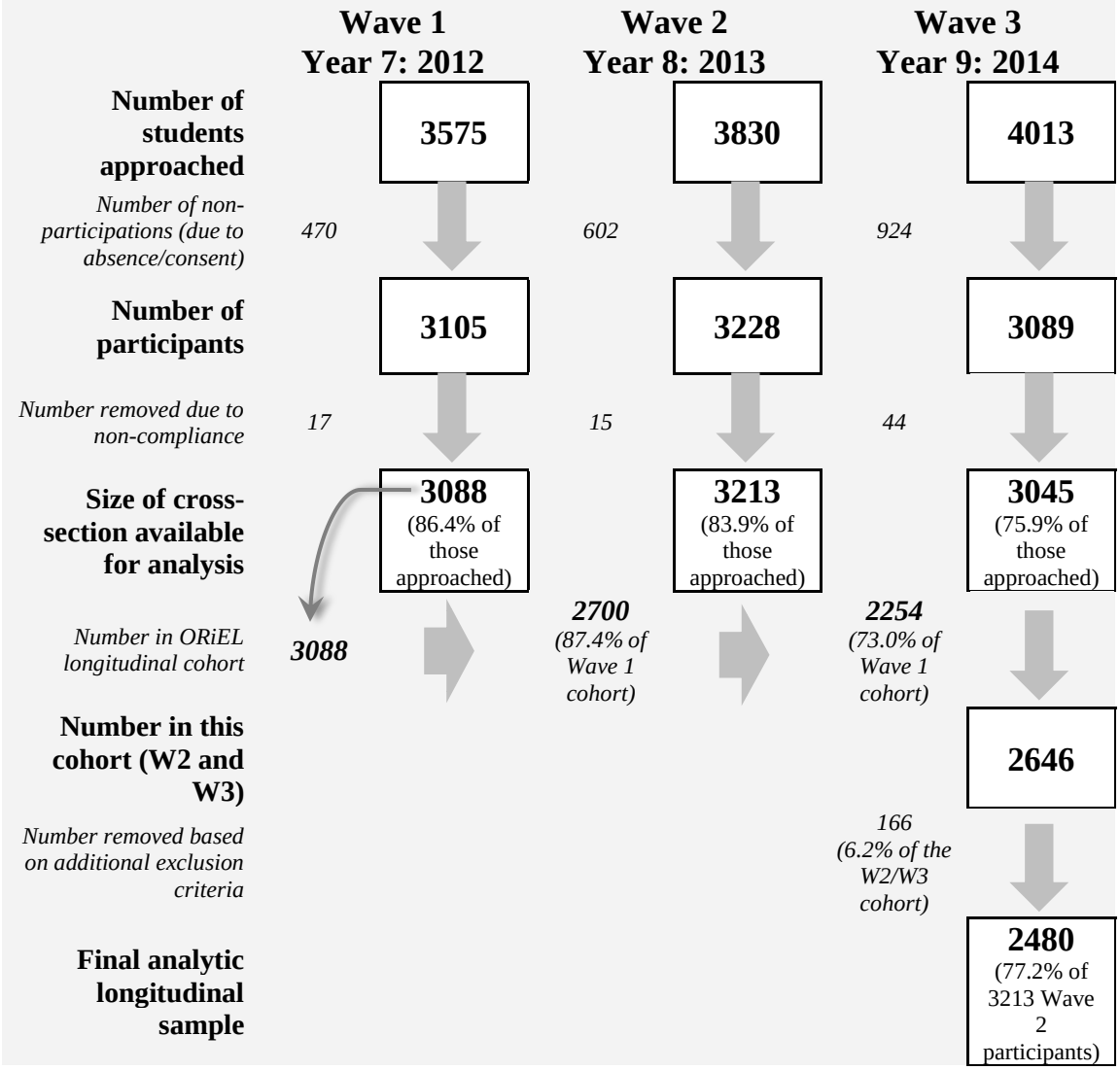

Figure 1: Participation flowchart

3.3 Measurement Instruments

The survey measures being used in the PhD are detailed below. All measures were included at baseline (2013) when the participants were aged 12-13 and at follow-up (2014) when the participants were 13-14 years of age respectively.

3.3.1 Primary Outcomes

3.3.1.1 Positive well-being

Westerhof and Keyes (2010) emphasise that hedonic well-being and eudaimonic well-being represent two different traditions in well-being research. Hedonic well-being refers to emotional well-being in the form of happiness, life satisfaction and positive affect, while eudaimonic well-being encapsulates aspects of an individual's psychological well-being (e.g. self-acceptance, autonomy, environmental mastery, and

personal growth) and an individual's social well-being (e.g. social acceptance, social coherence, social contribution, and social integration).

In this study, a measure of subjective well-being which includes items relating to both hedonic and eudaimonic well-being – the Warwick-Edinburgh Mental Well-being Scale (WEMWBS) (Tennant et al., 2007) – was used. The WEMWBS is a 14 item self-report measure of subjective well-being in the past two weeks (e.g. "I've been feeling hopeful about the future", "I've been feeling useful" and "I've been feeling close to other people"). Item responses are given according to five-categories: "none of the time" (1), "rarely" (2), "some of the time" (3), "often" (4) and "all of the time" (5). Scores across each item are then added together so that total scores on the WEMWBS range from 14 (lowest mental well-being) to 70 (highest mental well-being). Tennant et al. (2007) found that the WEMWBS showed good content validity, high correlations with other mental health and well-being scales, no ceiling effects, good internal consistency (Cronbach's alpha=0.89), and high test-re-test reliability at one week (0.83). The WEMWBS has been validated for use in adolescents (Clarke et al., 2011) and has been shown to detect statistically important changes at the group and individual level in a variety of community settings making it suitable for use in evaluation of interventions (Maheswaran, Weich, Powell, & Stewart-Brown, 2012). The WEMWBS scale showed good internal consistency at baseline (α =0.88) and follow-up (α =0.90).

In line with the approach taken by Stranges, Samaraweera, Taggart, Kandala, and Stewart-Brown (2014), for the purposes of this study the WEMWBS scores have been collapsed into categories as there were ceiling and floor effects present in the distribution of total scores within this sample which violated assumptions of normality and rendered a linear regression approach inappropriate and a transformation to a normal distribution was not possible. As per the approach of Stranges et al. (2014) WEMWBS scores were categorised such that those with scores within one standard deviation of the mean were categorised as having "average well-being", those with scores greater than one standard deviation below the mean were categorised as having "below average well-being", and those with scores greater than one standard deviation above the mean were categorised as having "above average well-being". Well-being scores were created separately by wave and separately by imputed dataset.

3.3.1.2 Depressive symptoms

Depressive symptoms were measured using the Short Moods and Feelings Questionnaire (SMFQ) (Angold et al., 1995). The SMFQ is a 13 item self-report

measure derived from the 30 item Mood and Feelings Questionnaire (MFQ). Each item contains a single statement and responses are based on feelings in the previous two weeks (e.g. “I cried a lot”, “I found it hard to think properly or concentrate” and “I felt I was no good any more”). Responses are given along a 3-point scale from “True” (2 points) to “Sometimes True” (1 point) to “Not True” (0 points). Scores for each item are added to give a total score for each participant which can range from 0 (lowest levels of depressive symptoms) to 26 (highest levels of depressive symptoms) and a score of >=8 indicates significant clinical depressive symptoms. Using this cut-off, the SMFQ has been previously shown to discriminate clinically referred child psychiatric subjects from unselected depressed subjects in a general population sample (Angold et al., 1995). Sharp, Goodyer, and Croudace (2006) also found evidence relating to the unidimensionality of the SMFQ scale and factor loadings of all items were high which suggested they were highly discriminating in relation to the latent trait. In relation to the ORiEL study specifically, the SMFQ showed good internal consistency at baseline (α =0.90) and follow-up (α =0.91).

3.3.1.3 Social anxiety

Social anxiety is measured using the three item Mini Social Phobia Inventory (Mini-SPIN), a self-report tool for social anxiety disorder (Connor, Kobak, Churchill, Katzelnick, & Davidson, 2001). Each item contains a single statement (e.g. “fear of embarrassment causes me to avoid doing things or speaking to people”, “I avoid activities in which I am the centre of attention”, and “being embarrassed or looking stupid are among my worst fears”). Responses are given along a 5-point scale: 0 (“not at all”), 1 (“a little bit”), 2 (“somewhat”), 3 (“very much”), and 4 (“extremely”). Scores are summed for the three items and total scores ranged from 0 (lowest level of social anxiety) to 12 (highest level of social anxiety). A score of >= 6 indicates significant symptoms of social anxiety. Using this cut-off, the mini-SPIN has good psychometric ability for screening social phobia in adolescents in the general population (Ranta, Kaltiala-Heino, Rantanen, & Marttunen, 2012). The mini-SPIN social anxiety scales showed good internal consistency at baseline (α =0.80) and follow-up (α =0.84).

3.3.2 Exposure variables

3.3.2.1 Social media use

Social media use was explored in terms of frequency of instant messaging (IM) and social networking site (SNS) use. In the literature review, it was argued that simply looking at “social media use” as one broad construct is insufficient and we need to

conduct research which explores social media use under particular conditions as the social world and available technologies continue to evolve (Livingstone & Smith, 2014). Based on this justification, different social media platforms – IM and SNS in this case – are theorised as representing distinct facets of social media use either because IM and SNS use are independent of one another, or because IM and SNS use show different associations with mental health outcomes, or both. The overlap between IM and SNS use will be explored within the results chapter.

Four items from the EU Kids Online Questionnaire (EU Kids Online, 2010) assessed SNS and IM use. All items were piloted with 60 students from the ORiEL study to determine their suitability for use within this cohort. First, participants were asked how often they use IM (e.g. BBM, WhatsApp) and responses were given along a 5-point scale including: "several times a day" (1), "every day or almost every day" (2), "once or twice a week" (3), "less than once a week" (4), and "never" (5). For analysis purposes and to reduce the number of categories for the imputation, this variable was further collapsed to make a 4 category variable. To do this the two smallest categories "once or twice a week" and "less than once a week" were combined to form a "twice a week or less" category which represented 13.3% of participants at both Wave 2 and Wave 3. Participants were then asked whether they had their own profile on an SNS (responses: Yes/No) and how often they visited social networking profiles (their own or someone else's) in the past 12 months with responses on the same 5-point scale as the IM question. As with IM use, this variable was further collapsed into a four category variable for analysis purposes so that the "once or twice a week" and "less than once a week" were combined to form a "twice a week or less" category which comprised 24.3% participants at Wave 2 and 23.9% at Wave 3.

Finally, in order to be able to describe adolescent SNS use, participants were asked to identify which SNS they use most. Options for this question were based on adolescent feedback during the pilot study and included Facebook, Instagram, and Twitter and there was a space where adolescents could indicate "other SNS". This item was used descriptively but as there were no hypotheses relating to differences in outcomes between SNS, analyses were not performed differentiating by SNS.

3.3.2.2 Cyberbullying involvement

A six item measure used by Ybarra et al. (2007) was selected for use within this current study. This measure includes three items which relate specifically to experiences of being a victim of cyberbullying. In reference to the previous 12 months, participants were asked how often they had "received rude or nasty comments from someone online", "become the target of rumours spread online", and "received threatening or aggressive comments online". Responses were provided along a 6-point scale: "every day or almost every day" (1), "once or twice a week" (2), "once or twice a month" (3), "a few times a year" (4), "less than a few times a year" (5), and "never" (6). Three items were also used to assess perpetration of cyberbullying in the previous year. Participants were asked, in reference to the previous 12 months, how often they had "sent rude or nasty comments to someone online", "spread rumours about someone else online", and "sent threatening or aggressive comments to someone online". Item responses were given along the same scale as the cybervictimisation items. The internal consistency of the cybervictimisation items was good at baseline (α =0.89) and follow-up (α =0.88), as was the internal consistency of the three cyberbullying items (α =0.91 (baseline) and 0.89 (follow-up).

These items were then collapsed, as per the approach of Ybarra et al. (2007) to give two three category variables. The first variable referred to frequency of victimisation by cyberbullying and was coded as "never" (1), "infrequently" (i.e. one or more victimisation experiences occurred less frequently than monthly over the past 12 months) (2), and "frequently" (i.e. one or more of the victimisation experiences occurred monthly or more frequently" (3). The second variable referred to perpetration of cyberbullying and was coded as "never" (1), "infrequently" (i.e. perpetrated one or more acts of cyberbullying less frequently than monthly over the past 12 months), and "frequently" (i.e. perpetrated at least one act of cyberbullying monthly or more frequently over the past 12 months). Based on these two variables it was then possible to extrapolate whether participants were involved in cyberbullying over the previous year as bullies, victims, or bully-victims or not at all using both a lenient criterion which allowed for any involvement over the previous year and also with a more stringent criterion which categorised participants by frequent involvement in cyberbullying as a frequent victim, frequent bully, frequent bully-victim, or not frequently involved.

3.3.2.3 Communication networks

Three questions were included from the EU Kids Online Study (EU Kids Online, 2010) to characterise the online communication networks of adolescents. First,

adolescents were asked how many friends (or followers) they had on the SNS they used most and responses were given according to six categories (up to 10/11-50/51-100/101-300/over 300/I do not have a SNS profile). As with IM and SNS use variables, this variable was collapsed into a 4 category variable for multiple imputation purposes. The "up to 10", "11-50" and "51-100" categories were combined, as these had low reports, to form an "up to 100" category resulting in 4 categories: I do not have a SNS profile/up to 100 friends/ 101 to 300 friends/over 300 friends.

Next, two questions were included to investigate whether the adolescent communicated online with strangers in the previous year. Participants were asked if they talked to people online they had never met in person and whether they shared personal information/photos online with someone they had never met in person (response options: Yes/No for each question). This was collapsed into a "communication with strangers" variable whereby adolescents were coded as 1 if "yes" was ticked for either of these two items and 0 if neither option was ticked.

3.3.3 Potential covariates and moderators

From a theoretical perspective, gender, ethnicity and SES were identified a priori from the literature as potential confounders in associations between social networking site/instant messaging use, cyberbullying involvement, characteristics of online networks and adolescent mental health. We determined whether or not each variable was statistically associated with the mental health outcomes and social networking site use in our study ($p<0.05$). These potential confounders were then adjusted for as appropriate in statistical analyses.

3.3.3.1 Gender

Previous research has identified associations between gender and mental health (Cyranowski, Frank, Young, & Shear, 2000; McLeod & Owens, 2004) and also between gender and i) screen-based media use (Espinoza & Juvonen, 2011; Roberts & Foehr, 2008), ii) cyberbullying involvement (Dempsey et al., 2009; Elgar et al., 2014), and iii) adolescent communication networks (Livingstone et al., 2014). Thus, based on existing literature gender is a likely potential confounder in any associations between social networking site or instant messaging use and adolescent mental health. The statistical justification for adjusting for gender will also be explored by examining the extent to which gender is associated with exposure and outcome variables. Gender will also be explored as a potential moderator in associations between social media

use/cyberbullying involvement/network characteristics and adolescent mental health based on the rationale outlined in the literature review.

3.3.3.2 Ethnicity

Previous research has identified links between ethnicity and mental health outcomes (Canty-Mitchell & Zimet, 2000; McLeod & Owens, 2004; Stansfeld et al., 2003) and also between ethnicity and i) social media use (Hargittai, 2007; Kim, Sohn, & Choi, 2011; Roberts & Foehr, 2008) ii) bullying (Tippett, Wolke, & Platt, 2013), and iii) adolescent communication networks (Lewis, Kaufman, Gonzalez, Wimmer, & Christakis, 2008). Participants in the ORiEL study were asked to report their race or ethnic background using a question based on the Census ethnicity question (Office for National Statistics, 2013), at each wave of the ORiEL study. The sample-specific and age appropriate categories used in the ORiEL study were derived via extensive piloting to capture the characteristics of the highly ethnically diverse sample in East London. Twenty-four ethnicity options were provided in the questionnaire and these were collapsed down (due to small numbers in certain groups) to 11 categories which represented the 11 largest self-reported ethnicity groups: White UK, White Mixed, White other, Asian Indian, Asian Pakistani, Asian Bangladeshi, Asian other, Black Caribbean, Black African, and Black other. Those in the "White: Mixed" category reported having multiple ethnicities to include at least one white and one non-white ethnic group. All other minority ethnic groups reported by study respondents were collapsed into an "other" category.

As students found the question difficult to comprehend in Wave 1 (aged 11-12) and reporting ethnicity became easier to participants as they got older, the Wave 3 ethnicity has been used for these analyses. The variables was derived such that Wave 3 ethnicity was used except where ethnicity was missing at Wave 3 in which case Wave 2 ethnicity was used and if Wave 3 and Wave 2 ethnicity was missing then ethnicity reported at Wave 1 was used. As it was impossible to impute ethnicity given the available data we collected, this approach maximised the number of participants for whom ethnicity data was available and thus reduced the number of participants dropped due to missing ethnicity information.

3.3.3.3 Socioeconomic status

Previous research has identified links between socioeconomic status (SES) and mental health outcomes in adolescence (Kieling et al., 2011; McLeod & Owens, 2004) and also between SES and i) social media use (Gitau, Marsden, & Donner, 2010;

Hasebrink, Görzig, Haddon, Kalmus, & Livingstone, 2011), ii) bullying involvement (Tippett & Wolke, 2014) and iii) adolescent communication networks (Livingstone et al., 2014). For this study, socioeconomic status was measured using the Family Affluence Scale (FAS II) (Boyce, Torsheim, Currie, & Zambon, 2006). The FAS II is a material deprivation based index of socioeconomic status and includes items asking how often the family has taken a holiday in the past year, if the family has access to a car/van/truck, if the adolescent shares their bedroom and the number of computers in the household. Total scores on the FAS II range from 0 to 9 and, using the cut-offs outlined by (Boyce et al., 2006), respondents are categorised along a three point ordinal scale as having low family affluence (score=0,1,2), medium family affluence (scores=3,4,5) or high family affluence (scores= 6,7,8,9).

Non-response is a common threat to validity of items measuring adolescent SES but rates of non-response on the FAS II are low in comparison to other measures (e.g. items inquiring about parental income, education, or occupation) (Boudreau & Poulin, 2009; Molcho, Nic Gabhainn, & Kelleher, 2007). The external validity of the FAS II has also been examined. For example, Boyce et al. (2006) aggregated scores at the country level and examined associations with Gross Domestic Product across 25 countries and found evidence to suggest good criterion validity. In addition, Boudreau and Poulin (2009) found that those who did not live with two parents and those who reported mother's education level less than a post-secondary degree were at higher risk of being categorised as having a lower level of family affluence, consistent with other studies examining associations between SES and family structure/parental education. Molcho et al. (2007) also found evidence for an association between FAS II scores and parental occupation. However, this scale showed poor internal consistency at baseline (α =0.37) and follow-up (α =0.36) in this study. An examination of previous research papers indicated that similarly poor internal consistency has been reported for this scale in the past (Boudreau & Poulin, 2009; Molcho et al., 2007). Given the poor internal consistency of the FAS and difficulties in measuring SES in adolescents (Currie, Elton, Todd, & Platt, 1997), an additional measure of self-reported free school meals status was also included. This is in line with the recommendation of Molcho et al. (2007) who suggested that the FAS II should not be used as the only measure of SES in adolescence given its poor internal reliability but that its high response rates and associations with other SES indicators suggest it may represent a useful complimentary measure of material affluence.

3.3.3.4 Intervention

There were no specific hypotheses as to how schools in the ORiEL intervention sample (those in Newham-based school) will differ from students not in the intervention sample (those in schools in Hackney, Tower Hamlets, or Barking and Dagenham) in terms of their social media use, cyberbullying involvement or the characteristics of their online networks. In addition, it is not possible to adjust for school and intervention simultaneously as this would lead to multicollinearity given the intervention variable is derived from the school variable, therefore, analyses were not adjusted for intervention as adjustment for school is theoretically more important.

3.3.3.5 School

Multilevel modelling by school was not feasible in this study due to the constraints imposed by the imputation software (discussed below in relation to the imputation). The multilevel multiple imputation procedure only allows for two-level multiple imputation and therefore school cannot be included in the models as a random effect, after we include pupils at level 1 and time at level 2. Therefore, analyses were adjusted for school as a fixed effect to go some way towards accounting for the clustering of students within schools, as advised by Harvey Goldstein (Personal Communication).

3.3.3.6 Perceived social support

Perceived social support was explored as a possible moderator in associations between social media use/cyberbullying involvement/network size characteristics and adolescents mental health. Perceived social support was measured using the Multidimensional Measure of Perceived Social Support (MSPSS) (Zimet, Dahlem, Zimet, & Farley, 1988). The MSPSS is a 12-item (7 response category) self-report measure of perceived social support from three sources – family, peer and significant other. Each item contains a single statement (e.g. “my family is willing to help me make decisions”, “I can talk about my problems with my friends”, and “there is a special person in my life who cares about my feelings”). Responses are on a 7 point scale including “disagree very strongly” (1), “disagree strongly”, “disagree mildly”, “neutral”, “agree mildly”, “agree strongly”, and “agree very strongly” (7). For total perceived social support, scores range from 12 (low perceived social support) to 84 (high perceived social support). Within the subscales, scores range from 4 (lowest perceived support from family/peers/significant other) to 28 (highest perceived support from family/peers/significant other).

For the purposes of this study, perceived social support was examined specifically in terms of perceived social support from peers and perceived social support from family. The MSPSS showed good internal consistency for the total score (α=0.90 (baseline) and 0.95 (follow-up)), the family subscale (α =0.90 (baseline) and 0.91 (follow-up)), and the peer subscale (α =0.92 (baseline) and 0.94 (follow-up)). For analysis purposes, perceived social support scores were categorised into tertiles indicative of low, medium and high levels of perceived social support. One variable was created with tertiles of the total score and a further three tertile variables were created for each of the family, peer, and significant other subscales at each wave. For the purposes of these analyses, only perceived peer support and perceived family support tertiles are used.

3.3.3.7 Parental monitoring

Parental monitoring was explored as a possible moderator in associations between social media use/cyberbullying involvement/network size characteristics and adolescents' mental health. Parental monitoring was measured using the parental monitoring sub-scale (10-items) of the Alabama Parenting Questionnaire (Shelton, Frick, & Wootton, 1996). Each item contains a single statement (e.g. "you fail to leave a note or let your parents know where you're going", "your parents leave the house and don't tell you where they are going", and "you come home from school more than an hour past the time your parents expect you to be home"). Responses are provided along a 5-point scale: "never" (1), "almost never" (2), "sometimes" (3), "often" (4), and "always" (5). Total scores range from 10 (highest level of parental monitoring) to 50 (lowest level of parental monitoring) and are created by summing together responses to all 10 items. This scale showed good internal reliability at baseline (α=0.85) and follow-up (α=0.86).

Total scores on this scale violated assumptions of normality and so a binary variable was created for analysis purposes where participants in the highest quartile were coded as 1 (low levels of parental monitoring) and those in the other three quartiles were coded as 0 (levels of parental monitoring not low). Given normality violations, it was not possible to include this variable as a total score in the imputation. Scores on this variable were highly skewed with a high floor effect. Those scoring in the highest quartile represented those with scores between 25 and 50 on the parental monitoring scale and thus represent those with the lowest levels of parental monitoring

in the cohort which informed the decision to use this cut-off to create the binary parental monitoring variable.

3.4 Procedure

3.4.1 Classroom procedure

This project was carried out in line with the protocols of the ORiEL study (Smith et al., 2012). Out of the 48 schools across the East London boroughs of Tower Hamlets, Hackney, Newham and Barking and Dagenham 25 schools (59.5% of those available) took part in the study. At initial recruitment in Year 7 (aged 11-12 years), the overall response rate was 86.4% (N=3088). Schools were given an information letter and a description of the study over the phone. Where a school was interested in participating, an information letter (Appendix 1) was sent to the school and the head teacher filled in the consent form where the school opted to take part in the study. Survey sessions were arranged to suit the timetable of the school staff and students. Where permitted, the research team visited the school to conduct an assembly in advance with students eligible for participation. Parent and student information sheets were provided to all eligible students along with an opt-out consent form for parents. These were handed out prior to survey sessions by teachers or by the research team at the assembly, where possible. Information sheets and consent forms are included in Appendix 2 (parent information sheet and opt-out form) and Appendix 3 (pupil information sheet and assent form) respectively. Sessions lasted for approximately one hour of school time during which time participants were invited to fill in the survey independently and, depending on session size, there were between three and eight research team members present. Sessions were carried out in a gym or classroom setting according to the resources available within each school. In advance of study sessions, class lists were provided by the school contact teachers to ensure that questionnaires were coded with each student's unique ID number for the session. An office protocol was established to ensure that participants were allocated the same ID number at each wave of the study and that new codes were generated for students new to the ORiEL study.

3.4.2 Ethical considerations and consent procedures

All researchers working on the project were Disclosure and Barring Service (DBS) checked (to ensure staff did not have any spent of unspent convictions, or cautions, and that local police did not hold any relevant information relevant to whether researchers should be working with children or adolescents) and ethical approval was

granted for the ORiEL project through Queen Mary University of London Ethics Committee (QMREC2011/40). All data is stored according to data protection laws and any identifiable electronic files are encrypted and password protected.

At the beginning of each session the study was explained to students and participants were given the opportunity to ask questions. The team leader also alerted participants to the assent form during each session, emphasising that participants could withdraw from the study if they did not wish to take part and assuring them that all data would be stored confidentially according to data protection laws. Once the project was explained, participants were invited to sign the assent form and begin working on the questionnaire independently. The research team remained present throughout each session to answer any questions and to assist students with the questionnaire. Assent forms were collected separately from the questionnaires so that participant names were not held alongside their questionnaire data. Overall, consent procedures required active consent from the school, passive consent from parents, and active assent from the participants themselves. Participants were given a copy of the assent form and information sheet containing contact details for the research team to take home.

3.4.3 School retention

In addition to the £1000 participation grant, schools were incentivised to continue to participate by providing certificates at the end of Wave 1, 2, and 3 of data collection (bronze, silver and gold respectively) and the research team were available to give talks at the school if desired/appropriate. Regular contact was made with participating schools in the form of emails and Christmas cards etc. In addition, participants and the schools were given a newsletter after each wave with details of the study progress and some preliminary descriptive findings. Schools, parents and the adolescent participants could also find more information about the study online by visiting the ORiEL website (www.orielproject.co.uk).

3.4.4 Data administration

Questionnaire data was entered by an external data-entry company. The company was provided with a data-entry protocol and data file and all data was double entered. Any ambiguity in participant responses was flagged by the data entry company. This led to a process of data cleaning which I performed along with another member of the ORiEL research team according to a data cleaning protocol. All data was checked using range and logic checks.

3.4.5 Analysis software

Analyses were carried out using Stata version 12 for Windows (StataCorp, 2011), as this package is particularly well-suited to handling complex survey designs. The multiple imputation was carried out in Realcom-impute (Carpenter, Goldstein, & Kenward, 2011) as this package is compatible with Stata and can handle multilevel multiple imputation.

3.5 Statistical Analysis Plan

3.5.1 Study retention

Loss of participants to follow-up can bias analyses in longitudinal research if the characteristics of those lost to follow-up are different from the characteristics of those in the longitudinal sample. To examine this, the 2480 students who participated at baseline and follow-up were compared to the full baseline sample of 3213 participants who completed the Wave 2 ORiEL questionnaire in terms of their demographic, mental health, and social media characteristics. The results of these comparisons are presented in Table 2 in the next chapter (page 114).

3.5.2 Addressing issues related to missing data

Missing data are common in social research and can introduce significant biases and incorrect inferences in analysis if not addressed. To avoid making biased inferences, longitudinal researchers should focus on dealing with missing data rather than ignoring this critical issue (Brunton-Smith, Carpenter, Kenward, & Tarling, 2012). Little and Rubin (2002) outlined a framework which is regularly used to classify missing data as being either i) missing completely at random (MCAR – the probability of data being missing does not depend on observed or unobserved factors), ii) missing at random (MAR – the probability of data being missing does not depend on unobserved factors, conditional on observed factors), or iii) missing not at random (MNAR – the probability of data being missing does depend on unobserved factors, conditional on observed factors).

Multiple imputation is a method of dealing with missing data whereby the distribution of the observed data is used to estimate a set of plausible values for the missing data (White, Royston, & Wood, 2011). In terms of social research, based on the flexibility, accessibility and relative ease of use of multiple imputation, this method is often favoured as a means of dealing with missing data (Brunton-Smith et al., 2012). Although it is possible to perform multiple imputation where data is MNAR, the standard implementation of multiple imputation assumes missing data is MAR. Multiple

imputation involves three main steps. These are outlined clearly by White et al. (2011) to include: i) the generation of multiply imputed datasets, ii) analysing each imputed dataset separately, and iii) combining estimates from multiple imputed data sets using Rubin's rules (Rubin, 1987).

Given that large data sets in social research often have missing data across a number of variables, multiple imputation by chained equations (MICE) represents an approach which can handle different variables types and generates a set of imputation models for each variable with missing data. White et al. (2011) describe the MICE process clearly by illustrating the way in which missing data is filled in cycles for each imputed data set individually. MICE involves regressing the first variable with missing data (χ_1) on all other variables, restricting the model to those with observed data on χ_1. Missing values on χ_1 are then replaced with a plausible set of values by simulated draws from the corresponding posterior predictive distribution (Rubin, 1984) of χ_1. This process is then repeated for all other variables with missing data to complete one cycle/iteration. This process is then repeated over several iterations. The number of iterations used depends on the data set but large numbers of cycles may be required when variables with missing data are strongly associated with one another (White et al., 2011). As multiple imputation is an iterative procedure, it is important to monitor patterns in the imputations to ensure models converge which can be tested by monitoring the regression coefficients at each cycle to see if they are stable (White et al., 2011). The MICE approach has been applied to address the issue of missing data in this PhD.

The following steps were carried out in order to complete the multiple imputation process; each step is discussed below:

1. Description of the missing data in the baseline and follow-up samples
2. Analysis of complete record data to assess support for MAR assumption
3. Preparation of data for multiple imputation
4. Multiple imputation procedure
5. Analysis of multiply imputed data

3.5.2.1 Description of missing data

In the first instance, Table 1 was drawn up to describe the amount of missingness in the dependent and independent variables in the baseline and follow-up samples.

Table 1: Missing data in study variables at baseline and follow-up

Variable	% Missing at baseline	% Missing at follow-up	% Missing at baseline and follow-up
Free school meals	1.8%	1.5%	0.2%
Family Affluence Scale (3 category variable)	3.7%	3.2%	0.3%
WEMWBS (3 category variable)	10.0%	7.0%	1.4%
SMFQ binary variable	6.3%	3.8%	0.8%
Mini SPIN binary variable	16.2%	6.3%	1.6%
Perceived peer support (tertile)	24.0%	8.7%	2.3%
Perceived family support (tertile)	23.6%	8.6%	2.4%
IM use	28.4%	5.1%	0.7%
SNS use	28.0%	6.0%	1.2%
Involvement in cyberbullying	29.6%	9.5%	3.1%
Communication with strangers	31.2%	11.3%	3.9%
Number of friends online	29.1%	7.3%	1.9%
Parental monitoring total	31.9%	15.7%	7.0%

Based on the descriptive data in Table 1, it is clear that missing data is more common at baseline than follow-up and it is most common in the social anxiety, social media, perceived social support, and parental monitoring variables. Given the surveys were a similar length at both waves, this suggests that age-related improvements to literacy and comprehension skills led to higher completion rates at follow-up. The variables with highest levels of missing are located at the back of the baseline and follow-up questionnaires. Many participants did not complete the full survey during the allotted time due largely to reading speed and English language comprehension, thus, length of survey session is likely to show a strong association with missingness in these measures.

3.5.2.2 Assessing support for MAR assumption

Patterns of missing data in the observed data set were investigated to assess the plausibility of an MAR assumption. At baseline, highest rates of missing data were observed for the social media items at the back of the questionnaire so this was explored as a likely factor to support the assumption of MAR. The length of survey sessions varied and session time ranged from 50 minute interrupted sessions (some sessions were interrupted to allow time for students to change their PE clothes or unavoidable issues

such as last minute room changes) to sessions over one hour in length (where teachers waited for all students to complete the survey). In longer sessions completion rates neared 100% while this rate dropped in instances where participants had less time. The majority of students filled the questionnaire in consecutive order from page one to the end, given issues with missing data it is difficult to define "completion". However, if completion is taken as responding to the last measure in the questionnaire, there is a positive association between having data on the final measure and session length (χ^2=80.60, p<0.001) This suggests that those who did not complete the social media variables most likely did not purposefully omit these items, and rather they simply did not reach them in the allotted time. To explore whether the assumptions of MAR were supported at baseline and follow-up, factors associated with missingness were identified.

It was hypothesised that the following factors would be related to students reaching the end of the survey during the allotted time: session length, gender, ethnicity, SES variables (free school meals & family affluence), school, and age. Notably, as longer survey sessions led to full survey completion, the session length was seen to constrain completion rates with those with literacy difficulties, lower IQ, or lower school attainment likely to take longer to complete the survey. During longer sessions these students did complete the survey and as such there was available data to support the MAR assumption. Based on this, a series of logistic regression analyses were carried out whereby these variables were simultaneously explored as factors which might explain the missingness in the following sets of baseline and follow-up factors: social anxiety, social media, perceived social support, and parental monitoring. Missingness was coded as "not missing" (0) or "missing" (1) for each variable. At baseline, using stepwise logistic regression analyses fully adjusted for each of the factors hypothesised to be associated with missing data, ethnicity and school were associated with missing data on all variables. Free school meals status and session time were associated with missing data on the SNS/IM use variables, cyberbullying variables, communication with strangers variable, number of friends online variable, peer and family support variables, and the parental monitoring variable. In addition, gender emerged as an additional risk factor for missing data on the parental monitoring and social anxiety scales with females less likely than males to be missing parental monitoring or social anxiety data. At follow-up, a similar approach was taken whereby a series of fully adjusted logistic regression analyses identified factors associated with missingness in

the social anxiety, social media, perceived social support, and parental monitoring variables. Results of these analyses suggested that session length, school (which dictated the session length in most cases), and gender were associated with missingness on all variables. In addition, ethnicity was associated with missing data relating to social anxiety, SNS network size, communication with strangers online, and parental monitoring data. While it is not possible to distinguish between MAR and MNAR using just the observed data, the inclusion of the aforementioned explanatory variables associated with missingness on the variables of interest in the model makes an assumption of MAR more plausible (White et al., 2011).

3.5.2.3 Preparation for multiple imputation

The REALCOM-IMPUTE (Carpenter et al., 2011) software was selected as an appropriate software to conduct multiple imputation using this data set as REALCOM-IMPUTE allows data to be imputed at two levels (participants are nested in waves). Using this software, the imputation model would not converge using the original set of variables proposed for this study. This is likely due to difficulties in fitting a complex set of models with several categorical variables requiring imputation by multinomial logistic regression (White et al., 2011). Originally, a decision was made to impute total scores for study variables and collapse them into sub-categories following the imputation. However, the MSPSS and parental monitoring scales had a highly non-normal distribution and high levels of missing data and there was concern as to the validity of imputed scores using this method. Therefore, a decision was made to recode the MSPSS total peer support and total family support subscales into tertiles prior to imputation. This transformation was performed with the caveat that following imputation these three tertiles may not be as equal in size and the tertile cut-off points were decided upon based on the complete data. The parental monitoring scale was transformed into a binary variable (low parental monitoring (lowest 25%) compared to the rest), as detailed above in the measures section.

Categorical variables with more than two categories were most problematic in the imputation model. Multinomial models need to be fitted to the data using categorical outcome variables and as such the convergence of the likelihood is unlikely given the sample size and number of categories. To address this problem, the number of categories in each categorical variable was reduced, where possible, in order to get the multiple imputation to run using the REALCOM-IMPUTE software. For this purpose, the SNS use, IM use, and online network size variables were each reduced to four

categories as described in the above measurement section. In addition, the four category cyberbullying involvement variable would not converge in the imputation model. To overcome this, separate variables for cybervictimisation and for cyberbullying were imputed and these were then combined post-imputation to give the four category variable (i.e. not involved, cybervictim, cyberbully, and cyberbully-victim) which allowed the imputation to run.

Currently available software for multiple imputation does not allow for the inclusion of interaction variables (particularly categorical interactions) in a way that was suitable for the purposes of this PhD. The most commonly used approach for including interaction terms is to include the product of two variables as an extra variable in the imputation model. However, given the number of hypothesised interactions and the large number of categories that would be produced in such variables in the current data, this was not feasible and after discussing possible solutions with software developers and experts in the field of multiple imputation, it was decided that interaction variables would have to be omitted from the imputation. In order to test hypotheses related to interactions it was decided that the data could be stratified by possible moderating variables in order to explore the extent to which the data seems to support interaction-related hypotheses. Therefore, all analyses of moderating effects presented in this thesis should be considered exploratory due to these methodological limitations.

To improve the accuracy in predicting missing values using multiple imputation the following variables, which are associated with variables with missing data (associated with missingness and with variable values), were also included in the imputation model: negative life events, average time using the internet per day, and whether the participant's mother is employed. This resulted in a total of 20 variables in the imputation and four additional fully observed variables (ethnicity, gender, age, and school). Participants who were missing ethnicity data were removed prior to imputation as imputing ethnicity data was deemed impossible given the available data we collected. In addition, participants missing all social media data or all mental health data were removed from analyses as it was agreed that there was insufficient predictive power to impute social media or mental health data for these cases. Finally, participants were excluded if they moved schools between waves as their data could not be attributed to a single school in the study. As discussed in Section **Error! Reference source not found.**, based on the exclusion criteria applied, 6.3% of the longitudinal sample was excluded from analyses.

3.5.2.4 Multiple imputation procedure

Baseline and follow-up data were included in the same multiple imputation model. This method aims to both preserve longitudinal associations between variables and strengthen the power of the imputation. The syntax for the multiple imputation was prepared in Stata using the *realcomImpute* command and this was then imported into REALCOM-IMPUTE. Data was imputed in long form and participants' ORiEL ID numbers were incorporated as the level two identifier. This Stata file was then imported into the REALCOM-IMPUTE software. A rule of thumb suggests that the number of data sets you produce should roughly equal the highest percentage of missing data in your imputation variables (Allison, 2012). This suggests the need for at least 32 imputed datasets for the current study and so 50 imputed datasets have been created for this project given the multilevel structure of the data which makes it more complex.

A burn-in of 30,000 iterations was carried out. This means that 30,000 iterations were carried out prior to creating any of the imputed data sets. The aim of this was to ensure the data had stabilised (i.e. to ensure that imputed missing values had converged to a stationary distribution) before the imputed datasets were generated. Then a gap of 500 iterations was left between imputed datasets to ensure imputed datasets were independent of one another. With a gap of 500 iterations between datasets 25,000 iterations were carried out in order to generate all of the imputed data files. While these 25,000 iterations were running, several graphs were monitored to ensure convergence had been achieved. These were graphs of the beta coefficients from the linear, and binary, ordinal, and multinomial logistic regression models fitted to each of the variables with missing data and they remained quite stable across iterations and did not give rise for concern.

Once the 50 data sets were generated and saved using REALCOM-IMPUTE these were then imported into Stata using the *realcomImputeLoad* command. The data was then transformed back into wide format to enable study analyses to be carried out as planned. Variables were coded where required (e.g. total SMFQ scores were collapsed into a binary depression variable where a "0" indicated the participant did not have depressive symptoms and a "1" indicated the participant had depressive symptoms). Truncated regression is not available in REALCOM-IMPUTE and so we manually truncated WEMWBS scores following the imputation so the scale for the imputed and unimputed data matched. WEMWBS total scores can range from 14 to 70. While the majority of imputed data fitted within this range, some scores of <14 were

imputed (n=111 (0.9%) of the 12450 imputed WEMWBS values at baseline and n=105 (1.2%) of the 8650 imputed WEMWBS values at follow-up). Some scores >70 were also imputed (n=778 (6.2%) of the 12450 imputed WEMWBS values at baseline and n=591 (6.8%) of the 8650 imputed WEMWBS values at follow-up). The variable was recoded so that scores <14 were recoded as 14 and scores of >70 were recoded as 70. The distribution of the observed WEMWBS looked approximately the same as the imputed truncated WEMWBS scores.

Finally, checks were performed to compare descriptive statistics in each of the imputed datasets to the complete record data. Given that missing data on most variables (i.e. social media use, social support, parental monitoring variables) was ascribed to students not reaching the end of the questionnaire, it was expected that the distribution of the imputed and unimputed data would be quite similar and this was supported by the checks carried out.

3.5.2.5 Analysis of multiple imputed data

Rubin (1987) presented a method for producing a single set of results from data analysis performed multiple times. First, estimates (e.g. regression coefficients) and standard errors must be calculated and saved for each analysis. Estimates are then combined such that the average of the individual estimates represents the overall estimate. To combine the standard errors the within-imputation and between-imputation must be calculated and Rubin (1987) presented a formula for combining these variance estimates to give an overall standard error value. In order to analyse the imputed data, the in-built imputation commands in Stata (Version 12) were applied to the data. Using these commands, each of the 50 imputed datasets were analysed separately and the regression coefficients were estimated for each dataset together with their variance-covariance matrices. These estimates were then combined using Rubin's rules (Rubin, 1987) (White et al., 2011) to provide overall estimate and overall standard error values.

3.5.2.6 Method for handling Outliers

The following rules were drawn up a priori in terms of addressing outliers in the data. It was planned that outliers would be investigated to ensure accuracy in data entry and data cleaning and errors corrected as appropriate. Remaining outliers would then be investigated to establish the nature of the outlier as they may be legitimate observations. A decision was made to address outliers on a case-by-case basis and to perform analyses with and without the outlier included where necessary. Where an outlying value creates an association which disappears once the outlier is removed, this case may be excluded

from analyses. In practice, there were no such outliers identified in the data and so the use of these rules was not necessary.

3.6 Assumption checks

The assumptions of each statistical test were tested in advance of its use to avoid inappropriate analysis of data.

3.7 Primary analysis

The study hypotheses were evaluated using a significance level of $p \leq 0.05$. All analyses were conducted using two-tailed testing. Despite the directionality of the study hypotheses, in keeping with the recommendations of Ruxton and Neuhäuser (2010), two-tailed testing was used as an effect in the opposite direction to that hypothesised will merit further exploration and will not equate to observing no effect (i.e. if communication with strangers is not associated with increased odds of depressive symptoms it is important to know whether communication with strangers is not associated with depressive symptoms at all or whether it is in fact associated with a decrease in odds of reporting depressive symptoms at follow-up).

Analysis was conducted in Stata (Version 12) (StataCorp, 2011). An epidemiological approach has been used for the analysis of data from this prospective cohort of adolescent data. A series of binary and multinomial logistic regression models were fitted to the data to test the study hypotheses. Binary logistic regression enables the examination of associations between a binary outcome and a number of exposure and/or confounding variables. Exposure variables may be categorical or continuous variables. The binary logistic regression analyses are reported based on Odds Ratios (ORs). For categorical exposure (predictor) variables the OR represents the odds of an outcome occurring in a particular exposure group compared to the odds of an outcome occurring in a reference or unexposed group (e.g. the odds of reporting depressive symptoms for cybervictims divided by the odds of reporting depressive symptoms for those not involved in cyberbullying). Binary logistic regression was used for two of the three study outcomes: depressive symptoms and social anxiety symptoms.

Multinomial logistic regression was used for models using well-being as the outcome given that the well-being scores have been collapsed into a three category variable. Output for the multinomial logistic regression is presented in terms of Relative Risk Ratios (RRR). The average well-being group was selected as the reference outcome category. Thus, RRRs for each exposure variable refer to the risk of low/high

well-being relative to average well-being for a particular exposure group relative to a reference exposure group (e.g. RRR=risk of being in low relative to average well-being category for females compared to males). Ordinal logistic regression has not been used as it was not assumed that the effect of exposure variables would be the same at each split of the categories of well-being. Ordinal logistic regression is based on the proportional odds assumption which states that the relationship between each pair of outcome groups is the same. This assumption was not supported by our data and as such a multinomial logistic regression was used instead.

To test longitudinal study hypotheses four models were fitted to the data for each outcome (depressive symptoms, social anxiety symptoms, and mental well-being) – an unadjusted model, a model adjusted for gender, a model adjusted for the additional covariates (ethnicity, family affluence, free school meals, and school), and a model with further adjustment for baseline mental health. To allow comparison with previous literature given that most studies have been cross-sectional, analyses will also be carried out on the baseline cross-sectional data. All analyses were carried out on the imputed data. For each model, the model fit is included in the tables. This F-test evaluates the null hypothesis that all regression coefficients in the model are equal to zero versus the alternative hypothesis that at least one is not. In addition, given that nested models are presented throughout (unadjusted models, adjusted for gender, additionally adjusted for other covariates, and additionally adjusted for baseline mental health), Wald tests are included for the main analyses. These Wald tests evaluate whether restricting additional parameters to zero considerably reduces the model fit. Likelihood ratio tests are reported instead of Wald tests for analyses based on complete record data detailed in Appendix 5.

Complete record analyses are included in Appendix 5. The complete record analyses have been carried out on the unimputed data to examine the extent to which imputed findings are comparable with analyses based on the imputed data. Multiple imputation was used with the aim of addressing biases in the data due to missing data and therefore, the imputed analyses have been included in the main text. Lastly, as a form of sensitivity analysis, the cyberbullying models were carried out additionally adjusting for a single “have you ever been bullied” item from a negative life events measure. This was the only variable available in the dataset to address traditional forms of bullying and the sensitivity analyses were carried out to determine whether

associations between cyberbullying and mental health were sustained after adjusting for this item.

Using the methodological approach outlined in this chapter, statistical analyses were carried out to test the study hypotheses. Analyses related to the primary research question are detailed in the next chapter, Chapter Four. Chapter Five then details analyses related to the secondary research questions.

CHAPTER FOUR

MAIN RESULTS – ASSOCIATIONS BETWEEN CHARACTERISTICS OF SOCIAL MEDIA USE AND ADOLESCENT MENTAL HEALTH

4 CHAPTER FOUR: MAIN RESULTS

The main results chapter is divided into four sections:

i) Sample characteristics
ii) Frequency of social media use and adolescent mental health
iii) Cyberbullying involvement and adolescent mental health
iv) Online network characteristics and adolescent mental health.

Section 4.1 includes details relating to study retention, a description of the socio-demographic characteristics of the sample and an exploration of the role of socio-demographic factors as covariates in analyses, followed by an account of the mental health characteristics of the sample. Section 4.2 addresses the first two study hypotheses focusing on SNS use and IM use and their associations with adolescent mental health. Section 4.3 contains the analyses relating to the third study hypothesis on the associations between cyberbullying and adolescent mental health. Finally, Section 4.4 examines associations between the characteristics of online networks and adolescent mental health and is related to the fourth and fifth study hypotheses.

4.1 Sample Characteristics

4.1.1 Study retention

Data was available for 3213 participants at Wave 2 of the ORiEL study, the baseline for this PhD. Given that 17.6% (n=567) of the participants present at baseline were absent at follow-up, and that a further 5.2% (n=166) of participants were dropped from analyses based on the exclusion criteria outlined in the methods chapter, it was important to examine whether the final analytic longitudinal sample upon which the analyses for this PhD are based were biased by the characteristics of participants lost to follow-up. For this purpose, those who were present at follow-up were compared to those who were not present at follow-up (e.g. because they dropped out of the study or were excluded based on exclusion criteria) to identify whether any demographic, mental health, or social media factors were associated with loss to follow-up as this may have introduced bias into the study analyses.

Table 2 below illustrates the baseline demographic characteristics of the complete record longitudinal sample of students who form the analytic sample for this PhD (n=2480), alongside the demographic characteristics of the full baseline sample (Wave 2) of 3213 adolescents. Results of a series of logistic regression analyses to identify factors associated with loss to follow-up are presented in Table 2. There was a 23% reduction in odds of being lost to follow-up among females compared to males. The gender breakdown of the full baseline sample was 56.7% male and 43.3% female compared to the longitudinal analytic sample where the gender imbalance was slightly reduced (55.2% male and 44.8% female). In addition, there was a 59% increase in odds of being lost to follow-up among students who reported their ethnicity as Black Caribbean compared to those reporting their ethnicity as White UK. Those reporting their ethnicity as White UK represented 16.8% of the full baseline sample and 16.9% of the longitudinal analytic sample while the proportion of participants reporting their ethnicity as Black Caribbean dropped from 5.2% in the full baseline sample to 4.6% in the longitudinal analytic sample. There was a 32% increase in odds of being lost to follow-up among those who received free school meals at baseline, representing 38.5% of the full sample compared to 36.9% of the longitudinal analytic sample. School differences in loss to follow-up were also observed. Based on fieldwork experiences, these differences were attributable to school differences in class timetabling which made it more difficult to follow-up students in certain schools.

No differences in loss to follow-up were observed by any of the social media variables (IM use, SNS use, cyberbullying involvement, size of online network, or communication with strangers online) or by the mental health variables (depressive symptoms, social anxiety symptoms, or mental well-being). There is strong evidence to suggest that the longitudinal sample is largely similar to the overall baseline sample, particularly as none of the main exposure or outcome variables were associated with study dropout. The three factors associated with dropout – gender, ethnicity and free school meals status – are all included as covariates in analyses.

Table 2: Socio-demographic characteristics of participants and links to study retention

	Full Baseline		Baseline Longitudinal Sample		Predictors of loss to follow-up (0=not lost; 1=lost)		
	N	%	N	%	OR	95% CI	p-val
Gender							
Male†	1822	56.7	1370	55.2	-	-	-
Female	1391	43.3	1110	44.8	**0.77**	**[0.65,0.91]**	**<0.001**
Total	3213	100.0	2480	100.0			
Ethnicity							
White: UK†	538	16.8	418	16.9	-	-	-
White: Other	477	14.9	377	15.2	0.92	[0.68,1.25]	0.600
White: Mixed	274	8.6	203	8.2	1.22	[0.87,1.71]	0.250
Asian: Indian	114	3.6	95	3.8	0.70	[0.41,1.19]	0.180
Asian: Pakistani	129	4.0	97	3.9	1.15	[0.73,1.80]	0.540
Asian: Bangladeshi	483	15.1	382	15.4	0.92	[0.68,1.24]	0.590
Asian: Other	120	3.8	86	3.5	1.38	[0.88,2.15]	0.160
Black: Caribbean	166	5.2	114	4.6	**1.59**	**[1.08,2.34]**	**0.020**
Black: African	344	10.8	262	10.6	1.09	[0.79,1.50]	0.600
Black: Other	350	11.0	278	11.2	0.90	[0.65,1.25]	0.540
Other	201	6.3	168	6.8	0.68	[0.45,1.05]	0.080
Total	3196	100.0	2480	100.0			
Free school meals							
No†	1936	61.5	1536	63.1	-	-	-
Yes	1210	38.5	900	36.9	**1.32**	**[1.12,1.57]**	**<0.001**
Total	3146	100.0	2436	100.0			
Family Affluence Scale							
FAS Low	220	7.1	173	7.2	0.88	[0.63,1.25]	0.490
FAS Moderate	1542	50.1	1210	50.6	0.89	[0.75,1.07]	0.210
FAS High†	1315	42.7	1006	42.1	-	-	-
Total	3077	100.0	2389	100.0			
Age							
Age (months)	Mean: 156.3	SD: 3.9	Mean: 156.3	SD: 3.9	1.00	[0.98,1.03]	0.750

† Reference group for regression analyses

4.1.2 Socio demographic characteristics

The socio-demographic characteristics of the study participants at baseline and follow-up are presented in Table 3. Variables with no information at follow-up represent factors that are fixed within individuals across both waves of data collection. The longitudinal sample contains a higher proportion of males (55.2%) compared to females (44.8%). This is largely attributable to the fact that three boys' schools participated in the project compared to one girls' school. The largest ethnic groups in the longitudinal sample include White UK (16.9%), White Other (15.2%), Asian Bangladeshi (15.4%), Black African (10.6%), and Black other (11.2%). The 11 category ethnicity variable being used in the current study highlights the large ethnic diversity in the study sample given the proportion of students reporting mixed ethnicities and the wide range of "other" ethnic backgrounds reported.

Taken together, the "other" ethnicities and mixed ethnicities reported account for 44.9% of the adolescent sample. Breaking down these large other and mixed ethnic groups shows that those categorised as White Other include those who reported their ethnicity as White but non-UK including (but not limited to) White Turkish (2.7%), White Kurdish (1%), White Lithuanian (2.5%), White Polish (1.5%), and White Irish (0.7%). Those who reported their ethnicity as White: Mixed include those who reported their ethnicity as Mixed White and Black African (2.0%), Mixed White and Black Caribbean (3.7%), Mixed White and Asian (1.7%) and Mixed White and any other ethnicity (0.8%) – a total of 8.2% of the longitudinal sample. The Black: African group (10.6%) includes those who self-reported their ethnicity as Black: African (8.6%) or Black: Somali (2.0%) while the Black: Other group (11.2%) mostly includes participants who reported their ethnicity as Black British (7.1%), Black African and Black Caribbean (0.5%), or Black British African (0.6%). Those categorised as Asian: Other (3.5%) in the 11 category ethnicity variable predominantly reported their ethnicity as British Bangladeshi (2.0%).

In terms of deprivation, approximately 37% of the sample reported receiving free school meals at baseline which dropped to 32% by follow-up, 7% reported having low family affluence at baseline which dropped to 5% at follow-up (using the FAS II), and at both waves approximately 51% reported having moderate family affluence. The number of participants who participated from each school within the longitudinal sample ranged from 75 to 184 students, with an average sample of 99 students per school. Approximately 29% of participants in the sample were based in the intervention

site (Newham) where the largest amount of Olympic regeneration was expected to occur.

Table 3: Socio-demographic characteristics of study participants

	Baseline		Follow-Up		χ^2
	N	**%**	**N**	**%**	
Gender					
Male	1370	55.2	-	-	
Female	1110	44.8	-	-	
Total	2480	100.0	-	-	
Ethnicity					
White: UK	418	16.9	-	-	
White: Other	377	15.2	-	-	
White: Mixed	203	8.2	-	-	
Asian: Indian	95	3.8	-	-	
Asian: Pakistani	97	3.9	-	-	
Asian: Bangladeshi	382	15.4	-	-	
Asian: Other	86	3.5	-	-	
Black: Caribbean	114	4.6	-	-	
Black: African	262	10.6	-	-	
Black: Other	278	11.2	-	-	
Other	168	6.8	-	-	
Total	2480	100.0	-	-	
Free school meals					
No	1536	63.1	1658	67.8	
Yes	900	36.9	786	32.2	
Total	2436	100.0	2444	100.0	χ^2=1.300; p<0.001
FAS					
Low	173	7.2	117	4.9	
Moderate	1210	50.7	1228	51.2	
High	1006	42.1	1056	44.0	
Total	2389	100.0	2401	100.0	χ^2=788.332; p<0.001
Intervention					
Non-intervention	1763	71.1	-	-	
Intervention site	717	28.9	-	-	
Total	2480	100.0			

4.1.3 Socio demographic characteristics as potential covariates

The socio-demographic factors identified above (gender, ethnicity, free school meals status, and family affluence) were identified as possible confounding factors a priori from the literature. Though theoretically plausible, in order to determine whether it was statistically important to adjust for each of these potential covariates, it was important to determine whether these potential confounding variables were associated with the main exposure and outcome variables upon which this PhD is focused. These analyses were based on the baseline data as the cross-sectional associations were expected to be stronger than longitudinal analyses. These associations are described in the eight tables in this section. Descriptive information in each of the tables is based on the complete record data while the binary and multinomial logistic regression analyses are based on analyses using the imputed data (n=2480). The ORiEL study is investigating the role of the intervention by comparing the health and health-related behaviours of participants in Newham schools to those in schools in boroughs outside Newham. However, differences in social media use by intervention were not hypothesised. It is not possible to adjust for both school and intervention as these two variables would lead to perfect multicollinearity in the regression models. Given that the theoretical plausibility for school differences in social media use and mental health is better established (Raudenbush & Willms, 2014), a decision was made to adjust analyses for school rather than intervention.

4.1.3.1 Socio-demographic factors associated with study exposure variables

4.1.3.1.1 Social networking site use

A series of univariable multinomial logistic regression analyses were performed to assess the associations between gender, ethnicity, free school meals status, and family affluence, with SNS use. Findings of these analyses, presented in Table 4, indicated a 42% reduction in risk of using SNS twice a week or less (RRR=0.58, 95% CI [0.46, 0.74]) and a 40% reduction in the risk of reporting never using SNS (RRR=0.60, 95% CI [0.46, 0.78]) among females compared to males. Compared to those who reported their ethnicity as White UK, there was some evidence to suggest that the risk of reporting being a non-user of SNS was 99% higher among those who reported their ethnicity as Asian Pakistani (RRR=1.99, 95% CI [1.00, 3.98]) and 55% higher among those who reported their ethnicity as Asian Bangladeshi (RRR=1.55, 95% CI [0.99, 2.45]) There was a 35% increase in risk of reporting being a non-user of SNS among those who received free schools meals compared to those who did not (RRR=1.35, 95%

CI [1.01, 1.79]). Similarly, there was an 88% increase in risk of reporting being a non-user of SNS among those with low levels of family affluence compared to their peers who reported high levels of family affluence (RRR=1.88, 95% CI [1.15, 3.09]).

Tests of model fit indicate that the model with gender improves estimation of social networking site use and there is some suggestion that family affluence also explains social networking site use. The data do not suggest that ethnicity and free school meals status are important variables in the estimation of adolescent social networking site use.

Table 4: Factors associated with social networking site use

	Several times a day		Every day or almost every day †		Twice a week or less		Never		*Model fit*	
	N	%	N	%	N	%	N	%	F	P-val
Gender (n=1786)										
Male†	198	20.0	206	20.8	377	38.1	208	21.0		
Female	189	23.7	246	30.9	**226[b] *****	**28.4**	**136[b] *****	**17.1**		
Total	387	21.7	452	25.3	603	33.8	344	19.3	**9.05**	**<0.001**
Ethnicity (n=1786)										
White: UK†	68	20.7	89	27.1	108	32.9	63	19.2		
White: Other	71	29.3	55	22.7	84	34.7	32	13.2		
White: Mixed	33	23.2	39	27.5	51	35.9	19	13.4		
Asian: Indian	11	14.3	19	24.7	32	41.6	15	19.5		
Asian: Pakistani	16	20.0	16	20.0	24	30.0	**24[a~]**	**30.0**		
Asian: Bangladeshi	62	19.9	65	20.8	109	34.9	**76[a~]**	**24.4**		
Asian: Other	14	21.2	17	25.8	21	31.8	14	21.2		
Black: Caribbean	13	19.4	19	28.4	21	31.3	14	20.9		
Black: African	36	20.1	44	24.6	55	30.7	44	24.6		
Black: Other	38	21.2	54	30.2	63	35.2	24	13.4		
Other	25	21.9	35	30.7	35	30.7	19	16.7		
Total	387	21.7	452	25.3	603	33.8	344	19.3	1.04	0.410
Free school meals (n=1755)										
No†	251	22.2	293	26.0	386	34.2	199	17.6		
Yes	132	21.1	147	23.5	208	33.2	**139[a] ***	**22.2**		
Total	383	21.8	440	25.1	594	33.8	338	19.3	1.68	0.170
FAS (n=1726)										
Low	24	17.6	29	21.3	43	31.6	**40[a*]**	**29.4**		
Moderate	186	21.0	231	26.1	302	34.1	166	18.8		
High†	162	23.0	177	25.1	237	33.6	129	18.3		
Total	372	21.6	437	25.3	582	33.7	335	19.4	2.06	0.055

** p<0.05; **p<0.01, ***p<0.001; ~ borderline evidence for an effect (p<0.06); † reference group for regression analyses*

Note: Proportions based on complete record data, models based on imputed data

a= increased multinomial logit estimate - This exposure more likely than reference exposure to be in this outcome category than to use SNS every day or almost every day

b= Decrease in multinomial logit estimate - This exposure group are less likely than the reference exposure group to be in this outcome category than to use SNS every day or almost every day

4.1.3.1.2 Instant messaging use

Another series of univariable multinomial logistic regression analyses were performed to assess the associations of gender, ethnicity, free school meals status, and family affluence, with IM use. As illustrated in Table 5, there was a reduction in risk of reporting IM use twice a week or less often (RRR=0.69, 95% CI [0.53, 0.90]) or never (RRR=0.73, 95% CI [0.53, 1.01]) compared to every day or almost every day among females relative to males. There was also a 99% greater risk of reporting using IM "twice a week or less" compared to "every day or almost every day" among those who reported their ethnicity as Asian Indian relative to those who reported their ethnicity as White UK (RRR=1.99, 95% CI [1.02, 3.92]). Asian Bangladeshi participants had a 63% greater risk of reporting being non-users of IM relative to every day or almost daily users compared to their peers who reported their ethnicity as White UK (RRR=1.63, 95% CI [0.99, 2.68]). Free school meals recipients had a 42% greater risk of being non-users of IM than to use IM every day or almost every day (RRR=1.42, 95% CI [1.03, 1.95]). Similarly, those with low levels of family affluence had a 2.41 times greater risk of being non-users of IM than to use IM every day or almost every day compared to their peers who reported high levels of family affluence (RRR=2.41, 95% CI [1.42, 4.10]).

Tests of model fit indicate that the model with gender, the model with free school meals, and the model with family affluence fit the data better than an intercept only model suggesting the importance of these variables as potential confounders in study analyses. Though differences in IM use were reported for Asian Indian and Asian Bangladeshi participants, the results did not provide evidence to suggest that the model regressing IM use on ethnicity fit the data better than an intercept only model.

Table 5: Factors associated with IM use

	Several times a day		Every day or almost every day †		Twice a week or less		Never		*Model fit*	
	N	%	N	%	N	%	N	%	F	P-val
Gender (n=1776)										
Male†	349	35.5	296	30.1	215	21.8	124	12.6		
Female	350	44.2	252	31.8	**115[b]** **	**14.5**	**75[b~]**	**9.5**		
Total	699	39.4	548	30.9	330	18.6	199	11.2	**6.86**	**<0.001**
Ethnicity (n=1776)										
White: UK†	146	44.1	98	29.6	52	15.7	35	10.6		
White: Other	95	40.6	81	34.6	36	15.4	22	9.4		
White: Mixed	62	43.7	47	33.1	23	16.2	10	7.0		
Asian: Indian	26	35.6	18	24.7	**23[a*]**	**31.5**	6	8.2		
Asian: Pakistani	26	32.5	22	27.5	16	20.0	16	20.0		
Asian: Bangladeshi	110	35.4	83	26.7	66	21.2	**52[a~]**	**16.7**		
Asian: Other	19	30.6	17	27.4	14	22.6	12	19.4		
Black: Caribbean	27	38.6	25	35.7	10	14.3	8	11.4		
Black: African	70	39.1	54	30.2	38	21.2	17	9.5		
Black: Other	73	40.8	66	36.9	28	15.6	12	6.7		
Other	45	39.1	37	32.2	24	20.9	9	7.8		
Total	699	39.4	548	30.9	330	18.6	199	11.2	1.27	0.150
Free school meals (n=1747)										
No†	457	40.5	349	30.9	214	19.0	108	9.6		
Yes	231	37.3	188	30.4	114	18.4	**86[a*]**	**13.9**		
Total	688	39.4	537	30.7	328	18.8	194	11.1	**2.72**	**0.043**
FAS (n=1717)										
Low	40	29.6	40	29.6	26	19.3	**29[a**]**	**21.5**		
Moderate	354	40.0	260	29.3	172	19.4	100	11.3		
High†	279	40.1	232	33.3	121	17.4	64	9.2		
Total	673	39.2	532	31.0	319	18.6	193	11.2	**3.42**	**0.002**

** p<0.05; **p<0.01, ***p<0.001; ~ borderline evidence for an effect (p<0.06); † reference group for regression analyses*

NOTE: Proportions based on complete record data, regression analyses based on imputed data

a= Increase in multinomial logit estimate - This exposure group are more likely than the reference exposure group to be in this outcome category than to use IM every day or almost every day

b= Decrease in multinomial logit estimate - This exposure group are less likely than the reference exposure group to be in this outcome category than to use IM every day or almost every day

4.1.3.1.3 Cyberbullying involvement

Outlined in Table 6, below, are the associations between gender, ethnicity, free school meals status, and family affluence, and involvement in cyberbullying as a cybervictim, cyberbully or cyberbully-victim. Results suggested a 24% decrease in risk of being a cyberbully-victim among females compared to males (RRR=0.76, 95% CI [0.60, 0.96]). In addition, risk of being a cybervictim was 41% lower among those who reported their ethnicity as Asian Bangladeshi compared to White UK (RRR=0.59, 95% CI [0.37, 0.95]). Those with low family affluence had a 42% lower risk of involvement as a cyberbully-victim compared to their peers with high family affluence (RRR=0.58, 95% CI [0.35, 0.97]).

While there was some evidence to suggest differences in cyberbullying involvement based on these individual factors, tests of model fit, however, did not provide convincing evidence to suggest that gender, ethnicity or the SES variables explained cyberbullying involvement better than a model with the intercept only.

Table 6: Factors associated with cyberbullying involvement

	Not involved†		Cyber-victims		Cyber-bullies		Cyberbully-victims		*Model fit*	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**F**	**P-Val**
Gender (n=1747)										
Male†	538	55.8	125	13.0	80	8.3	222	23.0		
Female	472	60.4	113	14.5	63	8.1	**134**[b*]	**17.1**		
Total	1010	57.8	238	13.6	143	8.2	356	20.4	2.00	0.113
Ethnicity (n=1747)										
White: UK†	183	57.5	55	17.3	21	6.6	59	18.6		
White: Other	118	49.2	39	16.3	21	8.8	62	25.8		
White: Mixed	61	47.3	23	17.8	9	7.0	36	27.9		
Asian: Indian	52	68.4	8	10.5	8	10.5	8	10.5		
Asian: Pakistani	51	65.4	8	10.3	4	5.1	15	19.2		
Asian: Bangladeshi	203	66.1	**32**[b*]	**10.4**	24	7.8	48	15.6		
Asian: Other	38	62.3	7	11.5	7	11.5	9	14.8		
Black: Caribbean	39	58.2	6	9.0	6	9.0	16	23.9		
Black: African	105	59.3	22	12.4	17	9.6	33	18.6		
Black: Other	99	55.3	18	10.1	17	9.5	45	25.1		
Other	61	53.0	20	17.4	9	7.8	25	21.7		
Total	1010	57.8	238	13.6	143	8.2	356	20.4	0.99	0.475
Free school meals (n=1718)										
No†	645	58.5	153	13.9	85	7.7	220	19.9		
Yes	348	56.6	81	13.2	57	9.3	129	21.0		
Total	993	57.8	234	13.6	142	8.3	349	20.3	0.61	0.607
FAS (n=1690)										
Low	89	67.9	15	11.5	7	5.3	**20**[b*]	**15.3**		
Moderate	502	57.7	124	14.3	71	8.2	173	19.9		
High†	382	55.4	93	13.5	62	9.0	152	22.1		
Total	973	57.6	232	13.7	140	8.3	345	20.4	1.23	0.285

** p<0.05; **p<0.01, ***p<0.001; ~ borderline evidence for an effect (p<0.06);* † reference group for regression analyses

NOTE: Proportions based on complete record data, regression analyses based on imputed data

a= Increase in multinomial logit estimate - This exposure group are more likely than the reference exposure group to be in this outcome category than to not be involved in cyberbullying

b= Decrease in multinomial logit estimate - This exposure group are less likely than the reference exposure group to be in this outcome category than to not be involved in cyberbullying

4.1.3.1.4 Size of online network

Results of a series of univariable multinomial logistic regression analyses investigating associations between gender, ethnicity, free school meals status, family affluence, and adolescents' online network size are illustrated in Table 7.

The data did not provide evidence for an association between gender and SNS network size. Risk of reporting having 101-300 friends relative to up to 100 friends was 33% lower among those who reported their ethnicity as White Other (RRR=0.67, 95% CI [0.45, 0.98]), 58% lower among those who reported their ethnicity as Asian Other (RRR=0.42, 95% CI [0.21, 0.85]), 42% lower among those who reported their ethnicity as Asian Bangladeshi (RRR=0.58, 95% CI [0.40, 0.84]), and 45% lower among those who reported their ethnicity as Black Caribbean (RRR=0.55, 95% CI [0.30, 1.02]), compared to those who reported their ethnicity as White UK. In addition, those who reported their ethnicity as Asian Bangladeshi had a 60% lower risk of reporting 300+ friends on their most used SNS compared to their peers who reported their ethnicity as White UK (RRR=0.40, 95% CI [0.25, 0.63]).

There was some evidence to suggest that those the risk of reporting have 101-300 friends relative to up to 100 friends online was 20% lower among those receiving free school meals compared to those who did not receive free school meals (RRR=0.80, 95% CI [0.64, 1.01]). In addition, risk of reporting 300+ friends online was lower among those with low (RRR=0.51, 95% CI [0.30, 0.88]) or moderate (RRR=0.64, 95% CI [0.50, 0.81]) family affluence compared to those with high levels of family affluence.

Tests of model fit suggested ethnicity differences and FAS differences in network size which improve the fit of the data beyond a model with the intercept only. However, the data did not suggest that gender or free school meals status provided explanatory power in models of adolescent network size.

Table 7: Factors associated with size of adolescents' online networks

	Does not have own SNS profile		Up to 100 friends †		101-300 friends		300+ friends		Model fit	
	N	%	N	%	N	%	N	%	F	P-Val
Gender (n=1759)										
Male†	127	13.0	346	35.4	310	31.7	195	19.9		
Female	105	13.4	258	33.0	237	30.3	181	23.2		
Total	232	13.2	604	34.3	547	31.1	376	21.4	0.57	0.634
Ethnicity (n=1759)										
White: UK†	37	11.7	95	30.1	112	35.4	72	22.8		
White: Other	21	8.8	80	33.3	**76**[b*]	**31.7**	63	26.3		
White: Mixed	8	5.8	46	33.1	52	37.4	33	23.7		
Asian: Indian	10	13.2	32	42.1	24	31.6	10	13.2		
Asian: Pakistani	18	22.8	27	34.2	25	31.6	9	11.4		
Asian: Bangladeshi	48	15.6	146	47.6	**81**[b**]	**26.4**	**32**[b***]	**10.4**		
Asian: Other	11	16.9	27	41.5	**12**[b*]	**18.5**	15	23.1		
Black: Caribbean	12	17.9	21	31.3	**19**[b~]	**28.4**	15	22.4		
Black: African	34	19.3	43	24.4	50	28.4	49	27.8		
Black: Other	16	9.0	51	28.7	63	35.4	48	27.0		
Other	17	14.7	36	31.0	33	28.4	30	25.9		
Total	232	13.2	604	34.3	547	31.1	376	21.4	**1.94**	**0.002**
Free school meals (n=1728)										
No†	142	12.7	378	33.9	362	32.4	234	21.0		
Yes	85	13.9	218	35.6	**177**[b~]	**28.9**	132	21.6		
Total	227	13.1	596	34.5	539	31.2	366	21.2	1.57	0.195
FAS (n=1697)										
Low	**29**[a*]	**21.5**	51	37.8	35	25.9	**20**[b*]	**14.8**		
Moderate	118	13.6	317	36.5	277	31.9	**157**[b***]	**18.1**		
High†	77	11.1	216	31.2	214	30.9	186	26.8		
Total	224	13.2	584	34.4	526	31.0	363	21.4	**5.15**	**<0.001**

** p<0.05; **p<0.01, ***p<0.001; ~ borderline evidence for an effect (p<0.06);* † reference group for regression analyses

Note: Proportions based on complete record data, models based on imputed data

a= Increase in multinomial logit estimate - This exposure group more likely than reference exposure group to be in this outcome category than to have up to 100 friends online

b= Decrease in multinomial logit estimate - This exposure group are less likely than the reference exposure group to be in this outcome category than to have up to 100 friends online

4.1.3.1.5 Communication with strangers online

Univariable logistic regression analyses were performed (Table 8) to assess factors associated with communication with strangers online. Results of these analyses revealed that odds of communication with strangers in the past 12 months were 21% lower among females compared to males (OR=0.79, 95% CI [0.65, 0.97]). In addition, compared to those who reported high family affluence, those who reported moderate levels of family affluence had a 23% reduction in odds of reporting communication with strangers over the past year (OR=0.77, 95% CI [0.51, 1.16]).

Tests of model fit suggest that gender and FAS each fit the data to better explain adolescent communication with strangers. However, results did not suggest that ethnicity and free school meals status variables fit the data well.

Table 8: Factors associated with online communication with strangers

	Did not communicate with strangers online †		Communicated with strangers online		*Model fit*	
	N	**%**	**N**	**%**		
Gender (n=1706)						
Male†	678	72.6	256	27.4		
Female	606	78.5	**166[b*]**	**21.5**		
Total	1284	75.3	422	24.7	**5.21**	**0.023**
Ethnicity (n=1706)						
White: UK†	245	78.5	67	21.5		
White: Other	169	72.5	64	27.5		
White: Mixed	97	75.2	32	24.8		
Asian: Indian	57	76	18	24		
Asian: Pakistani	54	71.1	22	28.9		
Asian: Bangladeshi	228	76.8	69	23.2		
Asian: Other	46	79.3	12	20.7		
Black: Caribbean	45	70.3	19	29.7		
Black: African	132	76.3	41	23.7		
Black: Other	131	73.6	47	26.4		
Other	80	72.1	31	27.9		
Total	1284	75.3	422	24.7	0.50	0.888
Free school meals (n=1678)						
No†	812	75.5	263	24.5		
Yes	451	74.8	152	25.2		
Total	1263	75.3	415	24.7	0.03	0.863
FAS (n=1651)						
Low	102	77.3	30	22.7		
Moderate	658	77	**196[b*]**	**23.0**		
High†	477	71.7	188	28.3		
Total	1237	74.9	414	25.1	**3.04**	**0.048**

** p<0.05; **p<0.01, ***p<0.001; ~ borderline evidence for an effect (p<0.06);* † reference group for regression analyses

NOTE: Proportions based on complete record data, regression analyses based on the imputed data

a=Increased odds of communication with strangers for this group compared to the reference exposure group

b= Decreased odds of communication with strangers for this group compared to the reference exposure group

4.1.3.2 Socio-demographic factors associated with study outcome variables

4.1.3.2.1 Depressive symptoms

The results outlined in Table 9 are based on a series of univariable logistic regression analyses to determine factors associated with depressive symptoms at baseline. Odds of reporting depressive symptoms were 2.13 times greater among females compared to males (OR=2.13, 95% CI [1.75, 2.61]). There was no evidence for an association between ethnicity, free school meals status, or family affluence, and reports of high levels of depressive symptoms.

Tests of model fit suggested that including gender in explaining depressive symptoms provided explanatory power beyond an intercept only model. Ethnicity, free school meals status, and FAS models, however, did not provide a good fit to the data.

Table 9: Factors associated with depressive symptoms

	Not depressed†		Depressive symptoms		*Model fit*	
	N	**%**	**N**	**%**	**F**	**P-Val**
Gender (n=2324)						
Male†	1083	84.3	201	15.7		
Female	741	71.3	**299**[a***]	**28.7**		
Total	1824	78.5	500	21.5	**55.88**	**<0.001**
Ethnicity (n=2324)						
White: UK†	312	77.4	91	22.6		
White: Other	262	75.3	86	24.7		
White: Mixed	142	77.6	41	22.4		
Asian: Indian	78	83.0	16	17.0		
Asian: Pakistani	67	73.6	24	26.4		
Asian: Bangladeshi	304	82.4	65	17.6		
Asian: Other	69	82.1	15	17.9		
Black: Caribbean	83	76.1	26	23.9		
Black: African	186	79.5	48	20.5		
Black: Other	203	81.5	46	18.5		
Other	118	73.8	42	26.3		
Total	1824	78.5	500	21.5	1.20	0.282
Free school meals (n=2324)						
No†	1127	77.9	319	22.1		
Yes	670	79.6	172	20.4		
Total	1797	78.5	491	21.5	1.24	0.266
FAS (n=2324)						
Low	129	77.7	37	22.3		
Moderate	885	77.4	259	22.6		
High†	752	80.0	188	20.0		
Total	1766	78.5	484	21.5	0.44	0.641

** p<0.05; **p<0.01, ***p<0.001; ~ borderline evidence for an effect (p<0.06);* † reference group for regression analyses

NOTE: Proportions based on complete record data, regression analyses based on the imputed data

a=Increased odds of depressive symptoms for this group compared to the reference exposure group

b= Decreased odds of depressive symptoms for this group compared to the reference exposure group

4.1.3.2.2 Social anxiety symptoms

Another series of logistic regression analyses were performed to identify factors associated with reports of high levels social anxiety symptoms. These analyses suggested the odds of reporting social anxiety symptoms were 76% greater among females compared to males (OR=1.76, 95% CI [1.45, 2.13]). There was no evidence for an association between ethnicity, free school meals status, or family affluence, and reports of symptoms of social anxiety, as illustrated in Table 10.

Tests of model fit suggested that including gender in explaining social anxiety symptoms provided explanatory power beyond an intercept only model. Ethnicity, free school meals status, and FAS models, however, did not provide a good fit to the data.

Table 10: Factors associated with social anxiety

	Not socially anxious†		Social anxiety symptoms		*Model fit*	
	N	**%**	**N**	**%**	**F**	**P-Val**
Gender (n=2079)						
Male†	881	78.6	240	21.4		
Female	654	68.3	**304**[a***]	**31.7**		
Total	1535	73.8	544	26.3	**33.09**	**<0.001**
Ethnicity (n=2079)						
White: UK†	267	72.4	102	27.6		
White: Other	234	77.7	67	22.3		
White: Mixed	113	71.5	45	28.5		
Asian: Indian	71	82.6	15	17.4		
Asian: Pakistani	57	69.5	25	30.5		
Asian: Bangladeshi	273	76.7	83	23.3		
Asian: Other	58	74.4	20	25.6		
Black: Caribbean	65	70.7	27	29.3		
Black: African	149	73.4	54	26.6		
Black: Other	161	73.5	58	26.5		
Other	87	64.4	48	35.6		
Total	1535	73.8	544	26.2	1.13	0.338
Free school meals (n=2047)						
No†	952	73.2	348	26.8		
Yes	559	74.8	188	25.2		
Total	1511	73.8	536	26.2	0.63	0.429
FAS (n=2017)						
Low	110	75.3	36	24.7		
Moderate	759	73.8	270	26.2		
High†	619	73.5	223	26.5		
Total	1488	73.8	529	26.2	0.23	0.794

** p<0.05; **p<0.01, ***p<0.001; ~ borderline evidence for an effect (p<0.06);* † reference group for regression analyses

NOTE: Proportions based on complete record data, regression analyses based on the imputed data

a=Increased odds of social anxiety symptoms for this group compared to the reference exposure group

b= Decreased odds of social anxiety symptoms for this group compared to the reference exposure group

4.1.3.2.3 Mental well-being

A series of multinomial logistic regression analyses were performed to examine associations between socio-demographic factors and mental well-being. Results are illustrated in Table 11 and show that risk of reporting below average well-being relative to average well-being was 56% greater among females compared to males (RRR=1.56, 95% CI [1.24, 1.98]). Conversely, risk of reporting above average well-being was 30% lower among females compared to males (RRR=0.70, 95% CI [0.54, 0.89]). Risk of reporting above average well-being was 68% greater among those who reported their ethnicity as White Mixed compared to those who reported their ethnicity as White UK (1.68, 95% CI [1.01, 2.79]). Risk of reporting below average well-being was 2.46 times greater among those with low (95% CI [1.60, 3.81]) and 1.57 times greater among those with moderate levels of family affluence (95% CI [1.21, 2.04]) compared to those with high family affluence. Risk of reporting above average well-being was 39% lower among those with moderate compared to high family affluence (RRR=0.61, 95% CI [0.47, 0.78]).

Tests of model fit suggested that including gender, ethnicity, or FAS in explaining mental well-being provided explanatory power beyond intercept only models. Free school meals status, however, did not provide a good fit to the data.

Table 11: Factors associated with well-being

	Below average well-being		Average well-being†		Above average well-being		*Model fit*	
	N	**%**	**N**	**%**	**N**	**%**	**F**	**P-val**
Gender (n=2231)								
male†	138	11.2	898	73	194	15.8		
female	**178**[a***]	**17.8**	716	71.5	**107**[b**]	**10.7**		
Total	316	14.2	1614	72.3	301	13.5	**13.08**	**<0.001**
Ethnicity (n=2231)								
White: UK†	65	16.5	283	71.8	46	11.7		
White: Other	41	12.4	253	76.4	37	11.2		
White: Mixed	31	17.9	112	64.7	**30**[a*]	**17.3**		
Asian: Indian	6	7	64	74.4	16	18.6		
Asian: Pakistani	23	25.8	57	64	9	10.1		
Asian: Bangladeshi	50	14.5	248	71.9	47	13.6		
Asian: Other	17	21	51	63	13	16		
Black: Caribbean	16	15.7	73	71.6	13	12.7		
Black: African	25	10.8	167	72	40	17.2		
Black: Other	23	9.6	182	75.8	35	14.6		
Other	19	12	124	78.5	15	9.5		
Total	316	14.2	1614	72.3	301	13.5	**1.70**	**0.027**
Free school meals (n=2195)								
No†	181	12.9	1035	73.7	189	13.5		
Yes	127	16.1	558	70.6	105	13.3		
Total	308	14	1593	72.6	294	13.4	1.69	0.184
FAS Categories (n=2161)								
Low	**33**[a***]	**22.1**	99	66.4	17	11.4		
Moderate	**174**[a**]	**15.9**	803	73.4	**117**[b***]	**10.7**		
High†	94	10.2	668	72.8	156	17		
Total	301	13.9	1570	72.7	290	13.4	**10.61**	**<0.001**

** p<0.05; **p<0.01, ***p<0.001; ~ borderline evidence for an effect (p<0.06);* † reference group for regression analyses

NOTE: Proportions based on complete record data, regression analyses based on imputed data

a= Increase in multinomial logit estimate - This exposure group are more likely than the reference exposure group to be in this outcome category than to report average well-being

b= Decrease in multinomial logit estimate - This exposure group are less likely than the reference exposure group to be in this outcome category than to report average well-being

4.1.3.3 Summary: Socio-demographic factors as covariates in study hypotheses

In summary, the above eight tables illustrate results of analyses relating to the associations between the identified potential covariates (gender, ethnicity, free school meals status, family affluence, school, and intervention) and each of the main study exposures (IM use, SNS use, cyberbullying involvement, communication with strangers, and number of friends on SNS) and study outcomes (depressive symptoms, social anxiety symptoms, and mental well-being). All of the identified covariates – gender, ethnicity, free school meals status, family affluence, school, and intervention – were associated with at least one of the exposure variables. Associations between gender, ethnicity, family affluence, and school and at least one of the study outcomes were identified. Free school meals status did not show an association with any of the study outcome variables (depressive symptoms, social anxiety symptoms, and well-being). However, given the very low Cronbach's alpha level for the FAS II, it was deemed appropriate to retain free school meals status in the analyses. In order to be able to make comparisons between study models and for consistency in the main analyses, it was deemed appropriate to adjust all main hypotheses for a uniform set of covariates. In summary, based on a priori decisions and findings of analyses presented in this section, a decision was made to adjust study models for gender, ethnicity, SES (free school meals and family affluence), and school.

4.1.4 Mental health characteristics of study sample

As the focus of this longitudinal study is on identifying factors predictive of adolescent mental health, it is important to understand the mental health characteristics of the overall sample. As illustrated in Table 12, at baseline, 21.5% of participants reported depressive symptoms, including 15.7% of males and 28.8% of females. Symptoms of social anxiety were reported by 26.3% of baseline participants including 21.4% of males and 31.7% of females. In addition, 14.2% of baseline participants reported below average well-being scores (greater than one standard deviation below the mean) including 11.2% of males and 17.8% of females.

Reports of depressive symptoms, social anxiety symptoms, and below average well-being increased over time. At follow-up, depressive symptoms were reported by 24.8% of participants including 15.2% of males and 36.4% of females. Social anxiety symptoms were reported by 28.5% of follow-up participants including 23.2% of males and 34.7% of females. Lastly, at follow-up, 15.4% of participants reported below average well-being including 11.4% of males and 20.3% of females.

Gender differences in reports of depressive symptoms, social anxiety symptoms, and mental well-being were observed both at baseline and follow-up. There was a twofold increase in odds of reporting depressive symptoms at baseline (OR=2.14, 95% CI [1.75, 2.61]) and a threefold increase in odds of reporting depressive symptoms at follow-up (OR=3.04, 95% CI [2.51, 3.69]) among females compared to males. Similarly, there was a 76% increase in odds of reporting social anxiety symptoms at baseline (OR=1.76, 95% CI [1.51, 2.16]) and an 81% increase in odds of reporting social anxiety symptoms at follow-up (OR=1.81, 95% CI [1.51, 2.16]) among females compared to males. In addition, risk of reporting below average compared to average mental well-being was 56% greater for females than males at baseline (RRR=1.56, 95% CI [1.24, 1.98]) and 75% greater for females than males at follow-up (RRR=1.75, 95% CI [1.38, 2.23]). Conversely, risk of reporting above average compared to average mental well-being was lower for females than males both at baseline (RRR=0.70, 95% CI [0.54, 0.89]) and follow-up (RRR=0.53 95% CI [0.41, 0.67]).

Tests of model fit suggested that including gender in models examining depressive symptoms, social anxiety symptoms, and mental well-being provided explanatory power beyond an intercept only model at baseline and at follow-up.

Table 12: Mental health characteristics at baseline and follow-up

	Baseline						Follow-up						*Model fit – baseline*		*Model fit – follow-up*	
	Male†		Female		Total		Male		Female		Total		F	P-val	F	P-val
	N	%	N	%	N	%	N	%	N	%	N	%				
Depressive symptoms																
Not depressed†	1083	84.4	741	71.3	1824	78.5	1109	84.8	686	63.6	1795	75.2				
Depressive symptoms	201	15.7	**299**[a***]	**28.8**	500	21.5	199	15.2	**392**[a***]	**36.4**	591	24.8				
Total	1284	100.0	1040	100.0	2324	100.0	1308	100.0	1078	100.0	2386	100.0	**55.88**	**<0.001**	**128.29**	**<0.001**
Social anxiety symptoms																
Not socially anxious†	881	78.6	654	68.3	1535	73.8	966	76.9	697	65.3	1663	71.5				
Social anxiety symptoms	240	21.4	**304**[a***]	**31.7**	544	26.2	291	23.2	**371**[a***]	**34.7**	662	28.5				
Total	1121	100.0	958	100.0	2079	100.0	1257	100.0	1068	100.0	2325	100.0	**33.09**	**<0.001**	**40.95**	**<0.001**
Well-being																
Below average well-being	138	11.2	**178**[a***]	**17.8**	316	14.2	144	11.4	**211**[a***]	**20.3**	355	15.4				
Average well-being†	898	73.0	716	71.5	1614	72.3	872	68.8	720	69.3	1592	69.0				
Above average well-being	194	15.8	**107**[b**]	**10.7**	301	13.5	252	19.9	**108**[b***]	**10.4**	360	15.6				
Total	1230	100.0	1001	100.0	2231	100.0	1268	100.0	1039	100.0	2307	100.0	**13.08**	**<0.001**	**28.05**	**<0.001**

*p<0.05; **p<0.01; ***p<0.001*;* † reference group for regression analyses; *NOTE: Proportions based on complete record data, regressions based on the imputed data;*

a= Increase in multinomial logit estimate – Females more likely than males to be in this category than the reference mental health category

b= Decrease in multinomial logit estimate - Females less likely than males to be in this category than the reference mental health category

4.1.4.1 Change in reports of mental health over time

This longitudinal study focuses on social media factors associated with future mental health of adolescents. It is, therefore, pertinent to examine the way in which reports of mental health outcomes change over time among participants in this cohort. As can be seen in Table 13, of the 2249 participants who had complete data on the SMFQ depression scale at both baseline and follow-up, 66.5% of these did not report depressive symptoms at either wave while 12.4% reported depressive symptoms at both baseline and follow-up. In addition, 12.2% of the sample reported depressive symptoms at follow-up only while 8.8% reported depressive symptoms at baseline only.

Table 13: Change in reports of depressive symptoms between baseline and follow-up

	Follow-up					
	No depressive symptoms		**Depressive symptoms**		**Total**	
Baseline	N	*%*	N	*%*	N	*%*
No depressive symptoms	1496	*66.5*	274	*12.2*	1770	*78.7*
Depressive symptoms	199	*8.8*	280	*12.4*	479	*21.3*
Total	1695	*75.4*	554	*24.6*	2249	*100.0*

Note: χ^2= 375.01, p<0.001

Next, focusing on social anxiety, Table 14 shows that of the 1964 participants who had complete data on the Mini-SPIN social anxiety scale at both baseline and follow-up, 58.5% of these did not report depressive symptoms at either wave while 13.7% reported social anxiety symptoms at both baseline and follow-up. In addition, 15.1% of the sample reported social anxiety symptoms at follow-up only while 12.7% reported social anxiety symptoms at baseline only.

Table 14: Change in reports of social anxiety symptoms between baseline and follow-up

	Follow-up					
	No social anxiety symptoms		**Social anxiety symptoms**		**Total**	
Baseline	N	*%*	N	*%*	N	*%*
No social anxiety symptoms	1149	*58.5*	296	*15.1*	1445	*73.6*
Social anxiety symptoms	250	*12.7*	269	*13.7*	519	*26.4*
Total	1399	*71.2*	565	*28.8*	1964	*100.0*

Note: χ^2= 183.09, p<0.001

Lastly, focusing on reports of mental well-being, as illustrated in Table 15, there were some changes in well-being reports over time. A sub-sample of 2093 participants completed the WEMWBS scale at both baseline and follow-up. Given the way in which the WEMWBS categories were created, the majority (54.4%) of these participants reported average well-being scores (within one standard deviation of the mean at baseline and follow-up). For 16.7% of participants, their baseline WEMWBS score was in a higher category than their follow-up WEMWBS score while a further 16.8% reported well-being scores in a higher category at follow-up than they had at baseline.

Table 15: Change in well-being between baseline and follow-up

	Follow-up							
	Below average well-being		**Average well-being**		**Above average well-being**		**Total**	
Baseline	N	*%*	N	*%*	N	*%*	N	*%*
Below average well-being	138	*6.6*	147	*7.0*	10	*0.5*	295	*14.1*
Average well-being	180	*8.6*	1139	*54.4*	195	*9.3*	1514	*72.3*
Above average well-being	12	*0.6*	156	*7.5*	116	*5.5*	284	*13.6*
Total	330	*15.8*	1442	*68.9*	321	*15.3*	2093	*100.0*

Note: χ^2= 404.71, p<0.001

4.2 Frequency of Social Media Use and Adolescent Mental Health

4.2.1 Social networking site use

At baseline, use of SNS was less frequent than IM use. Most participants reported using IM "twice a week or less often" (33.8%) while 21.7% reported using SNS "several times a day" and 19.3% reported never using SNS. As can be seen in Table 16, a higher proportion of females reported using SNS "several times a day" (23.7% compared to 20.0% of males) and "every day or almost every day" (30.9% of females compared to 20.8% of males) while a higher proportion of males than females reported using SNS "twice a week or less" (38.1% compared to 28.4% of females) or never (21.0% of males compared to 17.1% of females). Results of a multinomial logistic regression analysis suggested a 40-42% reduction in risk of reporting using SNS "twice a week or less" (RRR=0.58, 95% CI [0.46, 0.74]) or never (RRR=0.60, 95% CI [0.46, 0.78]) among females compared to males.

Table 16: SNS use at baseline

		Several times a day	**Every day or almost every day†**	**Twice a week or less**	**Never**	**Total**
Males†	N	198	206	377	208	989
	%	20	20.8	38.1	21	100
Females	N	189	246	**226**[b***]	**136**[b***]	797
	%	23.7	30.9	**28.4**	**17.1**	100
Total	N	387	452	603	344	1,786
	%	21.7	25.3	33.8	19.3	100
Model fit		*F=9.05*	*P<0.001*			

*p<0.05; **p<0.01; ***p<0.001; † reference group for regression analyses; **Note: χ^2= 36.41, p<0.001**

a= Increase in multinomial logit estimate – females more likely than males to be in this outcome category than to use SNS every day or almost every day

b= Decrease in multinomial logit estimate - females less likely than males to be in this outcome category than to use SNS every day or almost every day

A single item was included in the survey to examine which social networking sites were being used most frequently by adolescents. Most adolescents indicated more than one site as their "most used" SNS. Of the 1738 participants who answered this

question at baseline 61.5% reported using Facebook, 24.7% reported using Twitter, 15.2% reported using Instagram and 24.4% reported using another SNS (e.g. Tumblr, Kik). At baseline, 12.7% of those who responded to this question indicated that they did not have a SNS of their own. At follow-up, 2370 participants responded to this question. Facebook use was reported by 67.1%, Twitter was used by 27.5%, Instagram by 39.5%, 10% used Tumblr, and 17% reported using another SNS (e.g. Kik, Keek, Vine). At follow-up, 10.5% of those who gave a response to this question indicated they did not have a SNS profile of their own. There were no specific hypotheses relating to different mental health outcomes for use of one SNS compared to another and there was considerable overlap in SNS use so users of all SNS have been grouped together to test hypotheses.

4.2.2 Instant messaging use

As illustrated in Table 17, at baseline, a high proportion of participants (39.4%) reported using IM several times a day. In addition, 30.9% of the baseline sample reported using IM "every day or almost every day" while 11.2% reported never using IM at baseline. Focusing on the gender breakdown, females reported more frequent IM use with 44.2% of females (compared to 35.5% of males) reporting using IM "several times a day". In addition, 21.9% of males reported using IM twice a week or less compared to 14.5% of females and 12.6% of males reported never using IM compared to 9.5% of females. Results of multinomial logistic regression suggested a reduction in risk of reporting using IM "twice a week or less" (RRR=0.69 95% CI [0.53, 0.90]) or to never use IM among females compared to males (RRR=0.73 95% CI [0.53, 1.01]) at baseline.

Table 17: IM use at baseline

		Several times a day	**Every day or almost every day†**	**Twice a week or less**	**Never**	**Total**
Males†	N	349	296	215	124	984
	%	35.5	30.1	21.9	12.6	100
Females	N	350	252	**115**[b**]	**75**[b~]	792
	%	44.2	31.8	**14.5**	**9.5**	100
Total	N	699	548	330	199	1,776
	%	39.4	30.9	18.6	11.2	100
Model fit		*F=6.86*	*P<0.001*			

*p<0.05; **p<0.01; ***p<0.001; † reference group for regression analyses; **Note: χ^2= 25.44, p<0.001**

a= Increase in multinomial logit estimate – females more likely than males to be in this outcome category than to use IM every day or almost every day

b= Decrease in multinomial logit estimate - females less likely than males to be in this outcome category than to use IM every day or almost every day

4.2.3 Overlap between instant messaging and social networking site use

As can be seen in Table 18, there is overlap between IM and SNS use – 17.5% of those who provided SNS and IM data at baseline (n=1739) reported using both platforms several times a day, 13.5% reported using both platforms every day or almost every day, 11.4% reported using IM and SNS twice a week or less while 7.3% reported using neither platform. In total, 38.4% of participants (n=866) reported using IM and SNS as the same rate while 39.5% (n=706) reported using IM more frequently than SNS and 22.1% (n=167) reported using SNS more frequently than IM. In addition, results of a multinomial logistic regression regressing IM use at baseline on SNS use at baseline suggested a fivefold increase in risk of reporting using IM several times per day among those who use SNS "several time a day" relative to "every day or almost every day" (RRR=5.00, 95% CI [3.66, 6.84]). Those who use SNS "twice a week or less" (RRR=5.02, 95% CI [3.37, 7.46]) or never (RRR=5.51, 95% CI [3.44, 8.82]), relative to those who use SNS "every day or almost every day", were at an increased risk or reporting using IM "twice a week or less" compared to "every day or almost every day". In addition, those who use SNS "twice a week or less" (RRR=3.62, 95% CI [2.00, 6.56]) or never (RRR=18.03, 95% CI [9.92, 32.75]), relative to those who use SNS "every day or almost every day", were also at a greater risk of reporting never using IM compared to using IM "every day or almost every day".

While there is evidence to suggest that those who use SNS at high rates also use IM at high rates and those who use SNS at low rates also use IM at low rates there is also evidence to suggest that the overlap is not exact and these two platforms represent different aspects of social media use. In addition, it is still theoretically plausible that the associations between IM and SNS use and adolescent mental health may be different even if use of each platform is similar, given the different characteristics which distinguish IM from SNS use.

Table 18: Overlap between IM and SNS use at baseline

			Baseline IM use				
			Several times a day	**Every day or almost every day**	**Twice a week or less**	**Never**	**Total**
Baseline SNS use	**Several times a day**	N	305	57	12	8	382
		%	17.5	3.3	0.7	0.5	22.0
	Every day or almost every day	N	151	235	31	12	429
		%	8.7	13.5	1.8	0.7	24.7
	Twice a week or less	N	171	171	199	47	588
		%	9.8	9.8	11.4	2.7	33.8
	Never	N	60	70	83	127	340
		%	3.5	4.0	4.8	7.3	19.6
	Total	N	687	533	325	194	1739
		%	39.5	30.6	18.7	11.2	100.0

Note: χ^2= 767.87, p<0.001

4.2.4 Social networking site use and adolescent mental health

This section details the analyses performed on the imputed data to test the following hypothesis:

Hypothesis 1: Very high and very low levels of SNS use at baseline will be associated with poorer mental health (in the form of greater risk of depressive symptoms and social anxiety symptoms, and poorer well-being scores) at follow-up.

Research focusing on the associations between social media use and adolescent mental health is rare (even at the cross-sectional level), has shown mixed results to date, and has not been carried out within the UK. While the study hypotheses are longitudinal, the cross-sectional results are described to allow comparison with existing literature. The analytic approach, including the decision to carry out analyses on the baseline cross-sectional data and the longitudinal data was described in detail in Chapter 3.

4.2.4.1 Baseline cross-sectional analyses

4.2.4.1.1 Social networking site use and depressive symptoms

As illustrated in Table 19, results of a univariable logistic regression model revealed a 31% reduction in odds of reporting depressive symptoms among those who reported never using SNS compared to those who reported using SNS every day or almost every day. However, this association was attenuated after adjustment for gender as the data did not suggest evidence for an association between SNS use and depressive symptoms in either of the adjusted models.

Tests of model fit indicate that the unadjusted model, the model adjusted for gender, and the model additionally adjusted for ethnicity, SES, and school fit the data well. The Wald test comparing Model 2 to the unadjusted model indicates that adding gender to the model improves the fit of the data. The Wald test comparing Model 3 to Model 2, however, suggests that ethnicity, SES, and school do not contribute to further improving the model fit.

Table 19: Cross-sectional analysis – Odds ratios and 95% confidence intervals for the association between SNS use and depressive symptoms at baseline

		Model 1			Model 2			Model 3		
	N	**OR**	**P-val**	**95% CI**	**OR**	**P-val**	**95% CI**	**OR**	**P-val**	**95% CI**
SNS several times a day	387	1.04	0.789	[0.77,1.40]	1.07	0.651	[0.79,1.45]	1.03	0.868	[0.75,1.40]
SNS every day or almost every day†	452	1.00	-	-	1.00	-	-	1.00	-	-
SNS once or twice a week or less often	603	0.75	0.057	[0.56,1.01]	0.83	0.208	[0.61,1.11]	0.82	0.191	[0.60,1.11]
SNS never	344	**0.69**	**0.029**	**[0.49,0.96]**	0.75	0.098	[0.53,1.06]	0.73	0.084	[0.51,1.04]
		F	***P-val***		***F***	***P-val***		***F***	***P-val***	
Model fit		*3.20*	*0.022*		*13.40*	*<0.001*		*2.43*	*<0.001*	
Wald test					*51.23*	*<0.001*		*1.12*	*0.280*	

N refers to the N in the complete record data, models based on imputed data; † reference group for regression analyses
Model 1: Unadjusted; Model 2: Adjusted for gender; Model 3: Adjusted for gender, ethnicity, SES, & school (not presented)

4.2.4.1.2 Social networking site use and social anxiety symptoms

Based on the data illustrated in Table 20 this study did not provide evidence for a cross-sectional association between SNS use and social anxiety at baseline either in the unadjusted model, the model adjusted for gender, or the model additionally adjusted for ethnicity, free school meals, family affluence, and school.

Tests of model fit indicate that the unadjusted model does not fit the data better than an intercept only model. However, the model adjusted for gender, and the model additionally adjusted for ethnicity, SES, and school do fit the data better than an intercept only model. The Wald test comparing Model 2 to the unadjusted model indicates that adding gender to the model improves the fit of the data. The Wald test comparing Model 3 to Model 2, however, suggests that ethnicity, SES, and school do not contribute to further improving the model fit.

Table 20: Cross-sectional analysis – Odds ratios and 95% confidence intervals for the association between SNS use and social anxiety symptoms at baseline

		Model 1			Model 2			Model 3		
	N	**OR**	**P-val**	**95% CI**	**OR**	**P-val**	**95% CI**	**OR**	**P-val**	**95% CI**
SNS several times a day	387	0.98	0.873	[0.73,1.30]	1.00	0.985	[0.75,1.33]	0.98	0.906	[0.73,1.32]
SNS every day or almost every day†	452	1.00	-	-	1.00	-	-	1.00	-	-
SNS once or twice a week or less often	603	0.87	0.297	[0.66,1.13]	0.93	0.614	[0.71,1.23]	0.94	0.690	[0.71,1.25]
SNS never	344	0.88	0.419	[0.64,1.20]	0.94	0.718	[0.69,1.29]	0.97	0.871	[0.70,1.35]
		F	***P-val***		***F***	***P-val***		***F***	***P-val***	
Model fit		*0.51*	*0.676*		*7.60*	*<0.001*		*1.85*	*0.001*	
Wald test					*31.97*	*<0.001*		*1.24*	*0.152*	

N refers to the N in the complete record data, models based on imputed data; † reference group for regression analyses
Model 1: Unadjusted; Model 2: Adjusted for gender; Model 3: Adjusted for gender, ethnicity, SES, & school (not presented)

4.2.4.1.3 Social networking site use and mental well-being

Based on the data illustrated in Table 21 this study did not provide evidence for a cross-sectional association between SNS use and mental well-being at baseline either in the unadjusted model, the model adjusted for gender, or the model additionally adjusted for ethnicity, free school meals, family affluence, and school.

Tests of model fit indicate that the unadjusted model does not fit the data better than an intercept only model. However, the model adjusted for gender, and the model additionally adjusted for ethnicity, SES, and school fit the data better than an intercept only model. The Wald test comparing Model 2 to the unadjusted model indicates that adding gender to the model improves the fit of the data. The Wald test comparing Model 3 to Model 2 also suggests that additionally adjusting for ethnicity, SES, and school contributes to further improving the model fit.

Table 21: Cross-sectional analysis – Relative risk ratios and 95% confidence intervals for the association between SNS use and well-being at baseline

		Below average well-being						Above average well-being					
		Model 1		Model 2		Model 3		Model 1		Model 2		Model 3	
	N	RRR	95%CI	RRR	95%CI	RRR	95%CI	RRR	95%CI	RRR	95%CI	RRR	95%CI
SNS several times a day	387	1.11	[0.78, 1.59]	1.13	[0.79, 1.62]	1.11	[0.76, 1.60]	1.14	[0.78, 1.66]	1.12	[0.77, 1.64]	1.11	[0.75, 1.63]
SNS every day or almost every day†	452	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-
SNS Once or twice a week or less often	603	1.03	[0.74, 1.43]	1.10	[0.79, 1.53]	1.07	[0.76, 1.51]	1.01	[0.71, 1.43]	0.96	[0.70, 1.37]	0.99	[0.68, 1.43]
SNS Never	344	1.09	[0.75, 1.59]	1.15	[0.79, 1.70]	1.06	[0.71, 1.57]	1.27	[0.84, 1.91]	1.21	[0.80, 1.83]	1.24	[0.81, 1.89]
								F	***P-val***	***F***	***P-val***	***F***	***P-val***
Model fit								*0.38*	*0.893*	*3.2*	*0.001*	*1.85*	*<0.001*
Wald test										*13.09*	*<0.001*	*1.74*	*<0.001*

**p<0.05; **p<0.01; ***p<0.001; Model 1: Unadjusted; Model 2: adj. for gender; Model 3: adj. for gender, ethnicity, SES, & school (not presented); Base outcome= Average well-being (within 1 SD of mean); N refers to complete record data, models based on imputed data; † reference group for regression analyses; Base outcome: Average well-being (within 1SD of mean)*

4.2.4.2 Longitudinal analyses

4.2.4.2.1 Social networking site use and depressive symptoms

In line with the univariable cross-sectional logistic regression model at baseline, Table 22 below shows a 30% reduction in odds of reporting depressive symptoms at follow-up among those who reporting never using SNS at baseline. This association was attenuated, however, after adjustment for gender and the data did not indicate evidence for an association between SNS use at baseline and depressive symptoms at follow-up in the gender adjusted model or the model additionally adjusted for ethnicity, SES, and school.

Tests of model fit indicate that the unadjusted model, the model adjusted for gender, the model additionally adjusted for ethnicity, SES, and school, and the model additionally adjusted for baseline depressive symptoms fit the data well. The Wald test comparing Model 2 to the unadjusted model indicates that adding gender to the model improves the fit of the data. The Wald test comparing Model 3 to Model 2 suggests that ethnicity, SES, and school may not contribute to further improving the model fit. However, adding baseline depressive symptoms to the model does contribute to the model fit.

Table 22: Longitudinal analysis – Odds ratios and 95% confidence intervals for the association between SNS use at baseline and depressive symptoms at follow-up

		Model 1			Model 2			Model 3			Model 4		
	N	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**
SNS several times a day	387	1.06	0.672	[0.80,1.41]	1.11	0.479	[0.83,1.50]	1.09	0.579	[0.80,1.48]	1.09	0.600	[0.78,1.53]
SNS every day or almost every day†	452	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
SNS once or twice a week or less often	603	0.77	0.064	[0.59,1.02]	0.89	0.398	[0.67,1.17]	0.88	0.393	[0.66,1.18]	0.94	0.712	[0.69,1.29]
SNS never	344	**0.70**	**0.030**	**[0.51,0.97]**	0.80	0.176	[0.57,1.11]	0.80	0.202	[0.57,1.13]	0.89	0.543	[0.62,1.29]
		F	***P-val***		***F***	***P-val***		***F***	***P-val***		***F***	***P-val***	
Model fit		*3.25*	*0.021*		*27.88*	*<0.001*		*4.20*	*<0.001*		*9.32*	*<0.001*	
Wald test					*127.27*	*<0.001*		*1.38*	*0.0633*		*278.03*	*<0.001*	

Model 1: Unadjusted; Model 2: Adjusted for gender; Model 3: Adjusted for gender, ethnicity, SES, & school (not presented); Model 4: Model 3 additionally adjusted for baseline depressive symptoms; N refers to the N in the complete record data, models based on imputed data; † reference group for regression analyses

4.2.4.2.2 Social networking site use and social anxiety symptoms

There was a 24% reduction in odds of reporting social anxiety symptoms at follow-up among those who reported using SNS "twice a week or less often" at baseline compared to their peers who reported using SNS "every day or almost every day" in the unadjusted model. As illustrated in Table 23, while the unadjusted model suggested evidence for a negative association between frequency of SNS use at baseline and social anxiety symptoms at follow-up, the data did not provide evidence for an association between SNS use at baseline and social anxiety symptoms at follow-up after adjustment for gender or in the models additionally adjusted for ethnicity, SES, school, and baseline social anxiety symptoms.

Tests of model fit indicate that the unadjusted model regressing social anxiety symptoms on SNS use does not fit the data better than an intercept only model. However, the model adjusted for gender, the model additionally adjusted for ethnicity, SES, and school, and the model additionally adjusted for baseline social anxiety symptoms do fit the data better than intercept only models suggesting at least one parameter in each model is not equal to zero. The Wald test comparing Model 2 to the unadjusted model indicates that adding gender to the model improves the fit of the data. The Wald test comparing Model 3 to Model 2, suggests that ethnicity, SES, and school contributes to further improving the model fit. There is also evidence to suggest that adding baseline social anxiety symptoms to the model contributes to the model fit.

Table 23: Longitudinal analysis – Odds ratios and 95% confidence intervals for association between baseline SNS and social anxiety at follow-up

		Model 1			Model 2			Model 3			Model 4		
	N	**OR**	**P-val**	**95% CI**	**OR**	**P-val**	**95% CI**	**OR**	**P-val**	**95% CI**	**OR**	**P-val**	**95% CI**
SNS several times a day	387	0.97	0.827	[0.73,1.28]	0.99	0.946	[0.75,1.31]	1.03	0.859	[0.77,1.37]	1.04	0.814	[0.76,1.41]
SNS every day or almost every day†	452	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
SNS once or twice a week or less often	603	**0.76**	**0.045**	**[0.59,0.99]**	0.82	0.147	[0.63,1.07]	0.83	0.182	[0.63,1.09]	0.83	0.198	[0.62,1.10]
SNS never	344	0.80	0.156	[0.59,1.09]	0.86	0.338	[0.63,1.17]	0.87	0.373	[0.63,1.19]	0.86	0.362	[0.61,1.20]
		F	***P-val***		***F***	***P-val***		***F***	***P-val***		***F***	***P-val***	
Model fit		*1.87*	*0.133*		*9.59*	*<0.001*		*2.28*	*<0.001*		*5.86*	*<0.001*	
Wald test					*37.87*	*<0.001*		*1.43*	*0.042*		*155.86*	*<0.001*	

Model 1: Unadjusted; Model 2: Adjusted for gender; Model 3: Adjusted for gender, ethnicity, SES, & school (not presented); Model 4: Model 2 additionally adjusted for baseline social anxiety symptoms; N refers to the N in the complete record data, models based on imputed data; † reference group for regression analyses

4.2.4.2.3 Social networking site use and mental well-being

The data did not provide evidence for a longitudinal association between SNS use at baseline and reports of mental well-being at follow-up either in the unadjusted model, the model adjusted for gender, the model additionally adjusted for ethnicity, SES, and school, or the model additionally adjusted for baseline mental well-being. These results are illustrated in Table 24.

Tests of model fit indicate that the unadjusted model regressing mental well-being on SNS use does not provide a good fit to the data. However, the model adjusted for gender, the model additionally adjusted for ethnicity, SES, and school, and the model additionally adjusted for baseline mental well-being fit the data with evidence to suggest at least one parameter is not equal to zero. The Wald test comparing Model 2 to the unadjusted model indicates that adding gender to the model improves the fit of the data. The Wald test comparing Model 3 to Model 2, suggests that adjusting for ethnicity, SES, and school contributes to further improving the model fit. There is also evidence to suggest that adding baseline mental well-being to the model contributes to the model fit.

Table 24: Longitudinal analysis – Relative risk ratios and 95% confidence intervals for association between SNS use at baseline and well-being at follow-up

		Below average well-being								Above average well-being							
		Model 1		Model 2		Model 3		Model 4		Model 1		Model 2		Model 3		Model 4	
	N	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI
SNS several times a day	387	1.25	[0.86, 1.80]	1.27	[0.88, 1.84]	1.26	[0.86, 1.84]	1.25	[0.83, 1.88]	1.12	[0.76, 1.64]	1.26	[0.86, 1.84]	1.06	[0.71, 1.58]	0.99	[0.65, 1.51]
SNS every day or almost every day†	452	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-
SNS Once or twice a week or less often	603	0.96	[0.68, 1.35]	1.03	[0.73, 1.46]	1.03	[0.72, 1.47]	1.01	[0.69, 1.49]	1.10	[0.78, 1.56]	1.03	[0.72, 1.47]	1.01	[0.71, 1.45]	1.03	[0.71, 1.49]
SNS Never	344	0.88	[0.58, 1.34]	0.94	[0.61, 1.44]	0.92	[0.59, 1.43]	0.89	[0.55, 1.44]	1.46	[0.99, 2.16]	0.92	[0.59, 1.43]	1.33	[0.88, 1.99]	1.29	[0.84, 1.98]
										F	***P-val***	***F***	***P-val***	***F***	***P-val***	***F***	***P-val***
Model fit										1.41	0.206	6.73	<0.001	2.00	<0.001	5.06	<0.001
Wald test												26.74	<0.001	1.48	0.005	79.39	<0.001

**p<0.05; **p<0.01; ***p<0.001; Model 1: Unadjusted; Model 2: Adjusted for gender; Model 3: Adjusted for gender, ethnicity, SES & school (not presented); Model 4: Model 3 additionally adjusted for baseline well-being*

N refers to the N in the complete record data, models based on imputed data; † reference group for regression analyses

Base outcome: Average well-being (within 1SD of mean)

4.2.5 Instant messaging use and adolescent mental health

This section details the analyses performed on the imputed data to test Hypothesis 2:

Hypothesis 2: Very high and very low levels of IM use at baseline will be associated with poorer mental health (in the form of greater risk of depressive symptoms and social anxiety symptoms, and poorer well-being scores) at follow-up.

Similar to the approach taken for SNS use, analyses have been carried out on the baseline cross-sectional data, to examine the extent to which results compare with previous empirical studies, and also on the longitudinal data to test study hypotheses.

4.2.5.1 Baseline cross-sectional analyses

4.2.5.1.1 Instant messaging use and depressive symptoms

The association between IM use and depressive symptoms at baseline was investigated. Results of an unadjusted logistic regression suggested a 31% increase in odds of reporting depressive symptoms among those who reported using IM several times a day compared to those who reported using IM every day or almost every day. However, as can be seen in Table 25, this association was attenuated following adjustment for gender.

Tests of model fit indicate that the unadjusted model does not fit the data better than an intercept only model. However, the model adjusted for gender, and the model additionally adjusted for ethnicity, SES, and school fit the data with at least one parameter in these models not equal to zero. The Wald test comparing Model 2 to the unadjusted model indicates that adding gender to the model improves the fit of the data. The Wald test comparing Model 3 to Model 2, however, suggests that ethnicity, SES, and school do not contribute to further improving the model fit.

Table 25: Cross-sectional analysis – Odds ratios and 95% confidence intervals for the association between IM use and depressive symptoms at baseline

		Model 1			Model 2			Model 3		
SMFQ - baseline	**N**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**
IM several times a day - Baseline	699	**1.31**	**0.049**	**[1.00,1.72]**	1.28	0.074	[0.98,1.68]	1.30	0.064	[0.98,1.72]
IM every day or almost every day†	548	1.00	-	-	1.00	-	-	1.00	-	-
IM Once or twice a week or less often - Baseline	330	0.90	0.562	[0.63,1.28]	0.94	0.842	[0.67,1.38]	0.97	0.883	[0.67,1.40]
IM Never - Baseline	199	1.20	0.347	[0.82,1.75]	1.28	0.214	[0.87,1.88]	1.28	0.219	[0.88,1.91]
		F	***P-val***		***F***	***P-val***		***F***	***P-val***	
Model fit		*2.38*	*0.681*		*12.88*	*<0.001*		*2.43*	*<0.001*	
Wald test					*53.15*	*<0.001*		*1.15*	*0.248*	

Model 1: Unadjusted; Model 2: Adjusted for gender; Model 3: adjusted for gender, ethnicity, SES, & school (not presented); N refers to the complete record data, models based on imputed data; † reference group for regression analyses

4.2.5.1.2 Instant messaging use and social anxiety symptoms

As illustrated in Table 26, the data did not suggest evidence for a cross-sectional association between IM use and symptoms of social anxiety at baseline either in the unadjusted model, the model adjusted for gender, or the model additionally adjusted for ethnicity, SES, and school.

Tests of model fit indicate that the unadjusted model does not fit the data better than an intercept only model. However, the model adjusted for gender, and the model additionally adjusted for ethnicity, SES, and school fit the data well. The Wald test comparing Model 2 to the unadjusted model indicates that adding gender to the model improves the fit of the data. The Wald test comparing Model 3 to Model 2, however, suggests that ethnicity, SES, and school do not contribute to further improving the model fit

Table 26: Cross-sectional analysis – Odds ratios and 95% confidence intervals for the associations between IM use and social anxiety symptoms at baseline

		Model 1			Model 2			Model 3		
	N	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**
IM several times a day	699	1.09	0.466	[0.86,1.40]	1.07	0.574	[0.84,1.37]	1.08	0.555	[0.84,1.39]
IM every day or almost every day†	548	1.00	-	-	1.00	-	-	1.00	-	-
IM Once or twice a week or less often	330	0.87	0.363	[0.64,1.18]	0.91	0.559	[0.67,1.25]	0.93	0.673	[0.68,1.28]
IM Never	199	1.27	0.169	[0.90,1.80]	1.34	0.102	[0.94,1.89]	1.38	0.078	[0.96,1.99]
		F	***P-val***		***F***	***P-val***		***F***	***P-val***	
Model fit		*1.47*	*0.220*		*8.48*	*<0.001*		*1.95*	*<0.001*	
Wald test					*32.33*	*<0.001*		*1.25*	*0.115*	

Model 1: Unadjusted; Model 2: Adjusted for gender; Model 3: adjusted for gender, ethnicity, SES & school (not presented); N refers to the complete record data, models based on imputed data; † reference group for regression analyses

4.2.5.1.3 Instant messaging use and mental well-being

As illustrated in Table 27, at baseline, use of IM was not associated with reports of mental well-being either in the unadjusted model, the gender adjusted model, or in fully adjusted model.

Tests of model fit indicate that the unadjusted model does not fit the data better than an intercept only model. However, the model adjusted for gender, and the model additionally adjusted for ethnicity, SES, and school fit the data with at least one parameter in these models not equal to zero. The Wald test comparing Model 2 to the unadjusted model indicates that adding gender to the model improves the fit of the data. In addition, the Wald test comparing Model 3 to Model 2 suggests that ethnicity, SES, and school contribute to further improving the model fit.

Table 27: Cross-sectional analysis – Relative risk ratios and 95% confidence intervals for the association between IM use and well-being at baseline

		Below average well-being						Above average well-being					
		Model 1		Model 2		Model 3		Model 1		Model 2		Model 3	
	N	RRR	95%CI	RRR	95%CI	RRR	95%CI	RRR	95%CI	RRR	95%CI	RRR	95%CI
IM several times a day	699	1.21	[0.89, 1.65]	1.89	[0.87, 1.62]	1.19	[0.87, 1.64]	1.03	[0.74, 1.44]	1.04	[0.75, 1.46]	1.02	[0.72, 1.44]
IM every day or almost every day†	548	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-
IM Once or twice a week or less often	330	1.21	[0.81, 1.82]	1.27	[0.84, 1.90]	1.25	[0.83, 1.88]	1.20	[0.81, 1.77]	1.16	[0.79, 1.72]	1.18	[0.79, 1.76]
IM Never	199	1.37	[0.89, 2.10]	1.42	[0.93, 2.19]	1.23	[0.79, 1.92]	0.99	[0.61, 1.59]	0.96	[0.59, 1.72]	1.01	[0.62, 1.66]
								F	***P-val***	***F***	***P-val***	***F***	***P-val***
Model fit								*0.57*	*0.751*	*3.28*	*0.001*	*1.85*	*<0.001*
Wald test										*13.15*	*<0.001*	*1.72*	*<0.001*

**p<0.05; **p<0.01; ***p<0.001; Model 1 – Unadjusted; Model 2 –adj. for gender; Model 3: Adj. for gender, ethnicity, SES, & school (school not presented); Base outcome: Average well-being (within 1 SD of mean) N refers to the complete record data, models based on imputed data; † reference group for regression analyses*

4.2.5.2 Longitudinal analyses

4.2.5.2.1 Instant messaging use and depressive symptoms

As illustrated in Table 28 there was some evidence to suggest an association between IM use at baseline and depressive symptoms at follow-up. There was a 28% decrease in odds of reporting depressive symptoms at follow-up among those who use IM once or twice a week at baseline compared to those who reported using IM every day or almost every day. However, this association was attenuated following adjustment for gender.

Tests of model fit indicate that the unadjusted model, the model adjusted for gender, the model additionally adjusted for ethnicity, SES, and school, and the model additionally adjusted for baseline depressive symptoms fit the data better than an intercept only model. The Wald test comparing Model 2 to the unadjusted model indicates that adding gender to the model improves the fit of the data. The Wald test comparing Model 3 to Model 2 suggests that ethnicity, SES, and school may contribute to further improving the model fit. In addition, adding baseline depressive symptoms to the model contributes to the model fit.

Table 28: Longitudinal analysis – Odds ratios and 95% confidence intervals for the association between baseline IM use and depressive symptoms at follow-up

		Model 1			Model 2			Model 3			Model 4		
	N	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**
IM several times a day	699	1.24	0.090	[0.97, 1.58]	1.20	0.159	[0.93, 1.54]	1.21	0.153	[0.93,1.57]	1.12	0.446	[0.84,1.48]
IM every day or almost every day†	548	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
IM Once or twice a week or less often	330	0.72	0.060	[0.51, 1.01]	0.79	0.186	[0.55, 1.12]	0.79	0.214	[0.55,1.14]	0.78	0.205	[0.53,1.15]
IM Never	199	1.11	0.567	[0.78, 1.57]	1.22	0.292	[0.84, 1.75]	1.24	0.264	[0.85,1.80]	1.15	0.508	[0.76,1.73]
		F	***P-val***		***F***	***P-val***		***F***	***P-val***		***F***	***P-val***	
Model fit		*3.91*	*0.009*		*27.80*	*<0.001*		*4.26*	*<0.001*		*9.33*	*<0.001*	
Wald test					*122.22*	*<0.001*		*1.40*	*0.055*		*276.83*	*<0.001*	

Model 1: Unadjusted; Model 2: Adjusted for gender; Model 3: adj. for gender, ethnicity, SES, & school; Model 4: Model 3 adj. for baseline depressive symptoms; N refers to complete record data, models based on imputed data; † reference group for regression analyses

4.2.5.2.2 Instant messaging use and social anxiety symptoms

As illustrated in Table 29, similar to the baseline cross-sectional findings, no longitudinal association was identified between baseline IM use and adolescent social anxiety symptoms at follow-up in the unadjusted or adjusted logistic regression models.

Tests of model fit indicate that the unadjusted model regressing social anxiety symptoms on IM use does not provide a good fit to the data. However, the model adjusted for gender, the model additionally adjusted for ethnicity, SES, and school, and the model additionally adjusted for baseline social anxiety symptoms fit the data with evidence to suggest at least one parameter is not equal to zero. The Wald test comparing Model 2 to the unadjusted model indicates that adding gender to the model improves the fit of the data. The Wald test comparing Model 3 to Model 2, suggests that ethnicity, SES, and school may contribute to further improving the model fit. There is also evidence to suggest that adding baseline social anxiety symptoms to the model contributes to the model fit.

Table 29: Longitudinal analysis – Odds ratios and 95% confidence intervals for the association between baseline IM use and social anxiety at follow-up

		Model 1			Model 2			Model 3			Model 4		
	N	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**
IM several times a day	699	1.18	0.187	[0.92,1.50]	1.16	0.251	[0.90,1.48]	1.17	0.232	[0.91,1.50]	1.17	0.257	[0.89,1.52]
IM every day or almost every day†	548	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
IM Once or twice a week or less often	330	0.92	0.575	[0.67,1.24]	0.97	0.826	[0.71,1.32]	0.99	0.971	[0.73,1.36]	1.02	0.921	[0.73,1.41]
IM Never	199	1.02	0.926	[0.70,1.48]	1.07	0.743	[0.73,1.56]	1.03	0.867	[0.70,1.52]	0.94	0.764	[0.62,1.41]
		F	***P-val***		***F***	***P-val***		***F***	***P-val***		***F***	***P-val***	
Model fit		*1.19*	*0.310*		*9.05*	*<0.001*		*2.24*	*<0.001*		*5.82*	*<0.001*	
Wald test					*38.85*	*<0.001*		*1.43*	*0.043*		*155.24*	*<0.001*	

Model 1: Unadjusted; Model 2: adj. for gender; Model 3: Adjusted for gender, ethnicity, SES, & school; Model 4: Model 3 adjusted for baseline social anxiety. N for complete record data; models are based on imputed data; † reference group for regression analyses

4.2.5.2.3 Instant messaging use and mental well-being

Results of the unadjusted multinomial logistic regression to investigate the longitudinal association between IM use at baseline and mental well-being at follow-up suggested a 50% increase in risk of reporting below average well-being at follow-up among those who used IM several times a day at baseline compared to those who used IM every day or almost daily at baseline, as illustrated in Table 30). Though this association was slightly attenuated, after adjustment for gender, ethnicity, SES, school, and baseline well-being score there was still evidence to suggest a 45% increase in risk of reporting below average well-being among those who used IM several times a day. IM use was not associated with reports of above average well-being in the univariable models, the adjusted models, or the models additionally adjusted for baseline mental well-being.

Tests of model fit indicate that the unadjusted model regressing mental well-being on IM use does not provide a good fit to the data. However, the model adjusted for gender, the model additionally adjusted for ethnicity, SES, and school, and the model additionally adjusted for baseline mental well-being fit the data with evidence to suggest at least one parameter is not equal to zero. The Wald test comparing Model 2 to the unadjusted model indicates that adding gender to the model improves the fit of the data. The Wald test comparing Model 3 to Model 2, suggests that ethnicity, SES, and school contributes to further improving the model fit. There is also evidence to suggest that adding baseline mental well-being to the model contributes to the model fit.

Table 30: Longitudinal analysis – Relative risk ratios and 95% confidence intervals for the association between baseline IM use and well-being at follow-up

		Below average well-being								Above average well-being							
		Model 1		**Model 2**		**Model 3**		**Model 4**		**Model 1**		**Model 2**		**Model 3**		**Model 4**	
	N	**RRR**	**95% CI**	**RRR**	**95% CI**	**RRR**	**95% CI**	**RRR**	**95% CI**	**RRR**	**95% CI**	**RRR**	**95% CI**	**RRR**	**95% CI**	**RRR**	**95% CI**
IM several times a day	699	**1.50***	**[1.09, 2.06]**	**1.47***	**[1.07, 2.03]**	**1.47***	**[1.06, 2.05]**	**1.45***	**[1.02, 2.06]**	1.09	[0.80, 1.48]	1.11	[0.81, 1.52]	1.09	[0.79, 1.49]	1.09	[0.78, 1.52]
IM every day or almost every day†	548	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-
IM Once or twice a week or less often	330	1.02	[0.67, 1.56]	1.06	[0.70, 1.64]	1.10	[0.72, 1.70]	1.05	[0.66, 1.67]	1.31	[0.92, 1.86]	1.24	[0.87, 1.77]	1.22	[0.84, 1.76]	1.24	[0.84, 1.82]
IM Never	199	1.26	[0.79, 2.01]	1.32	[0.82, 2.10]	1.24	[0.76, 2.02]	1.19	[0.70, 2.00]	1.00	[0.63, 1.59]	0.96	[0.60, 1.52]	0.97	[0.60,1 .57]	0.98	[0.59, 1.61]
										F	***P-val***	***F***	***P-val***	***F***	***P-val***	***F***	***P-val***
Model fit										1.80	0.095	7.16	<0.001	2.04	<0.001	5.09	<0.001
Wald test												26.78	<0.001	1.47	0.005	79.22	<0.001

**p<0.05; **p<0.01; ***p<0.001; Model 1: Unadjusted; Model 2: Adjusted for gender; Model 3: Adjusted for gender, ethnicity, SES, & school (not presented); Model 4: Model 3 additionally adjusted for baseline well-being;*
N refers to the N in the complete record data, models based on imputed data; † reference group for regression analyses
Base outcome: Average well-being (within 1SD of mean)

4.3 Cyberbullying Involvement and Adolescent Mental Health

This section focuses on describing involvement in cyberbullying among participants in this adolescent cohort and on testing hypotheses relating to the impact of cyberbullying involvement on adolescent mental health in the form of depressive symptoms, social anxiety symptoms, and mental well-being.

4.3.1 Adolescent involvement in cyberbullying

Table 31 shows the proportion of participants who reported any involvement in cyberbullying over the previous 12 months as cybervictims, cyberbullies, and cyberbully-victims at baseline. Overall 1747 participants provided cyberbullying data at baseline. Of these participants, 42.2% reported some involvement in cyberbullying at least once over the past 12 months. As illustrated below, 13% of males and 14.5% of females reported involvement in cyberbullying as a cybervictim at least once over the previous 12 months. Cyberbullying involvement as a cyberbully at least once over the previous 12 months was reported by 8.3% of males and 8.1% of females, while a higher proportion of males (23.0%) than females (17.1%) reported involvement in cyberbullying as a cyberbully-victim at least once over the past 12 months. Results of a multinomial logistic regression regressing cyberbullying involvement on gender suggested a 24% reduction in risk of being a cyberbully-victim among females compared to males.

Table 31: Cyberbullying involvement at baseline

		Not involved†	Cybervictim	Cyberbully	Cyberbully -victim	Total
Male†	**N**	538	125	80	222	965
	%	*55.8*	*13.0*	*8.3*	*23.0*	*100.0*
Female	**N**	472	113	63	**134**[b*]	782
	%	*60.4*	*14.5*	*8.1*	*17.1*	*100.0*
Total	**N**	1,010	238	143	356	1,747
	%	*57.8*	*13.6*	*8.2*	*20.4*	*100.0*
Model fit		*F=2.00*	*P=0.113*			

*p<0.05; **p<0.01; ***p<0.001*; † reference group for regression analyses*; **Note: χ^2= 9.63, p=0.022**

a= Increase in multinomial logit estimate – females more likely than males to be in this outcome category than not involved in cyberbullying

b= Decrease in multinomial logit estimate - females less likely than males to be in this outcome category than not involved in cyberbullying

More frequent involvement in cyberbullying was also examined by focusing on those who reported involvement in cyberbullying "at least monthly" over the past 12 months. Table 32 below illustrates the proportion of participants reporting frequent involvement in cyberbullying (as cybervictims, cyberbullies, or cyberbully-victims) over the past 12 months. As illustrated below, at baseline, 17.1% of the sample reported being involved in cyberbullying at least monthly over the past 12 months. Frequent involvement in cyberbullying as a cybervictim was similar for males (5.9%) and females (6.0%) while about twice as many males reported involvement as frequent cyberbullies (4.3%) and frequent cyberbully-victims (10.9%) compared to females (2.1% and 4.2% respectively). Results of a multinomial logistic regression regressing cyberbullying involvement on gender suggested a 44% reduction in risk of being a cyberbully and a 56% reduction in risk of being a cyberbully-victim among females compared to males.

Table 32: Frequent involvement in cyberbullying at baseline

		Not involved†	**Frequent cybervictim**	**Frequent cyberbully**	**Frequent cyberbully-victim**	**Total**
Male†	**N**	762	57	41	105	965
	%	*79.0*	*5.9*	*4.3*	*10.9*	*100*
Female	**N**	686	47	**16**[b*]	**33**[b***]	782
	%	*87.7*	*6.0*	*2.1*	*4.2*	*100*
Total	**N**	1,448	104	57	138	1,747
	%	*82.9*	*6.0*	*3.3*	*7.9*	*100*
Model fit		*F=6.47*	*P<0.002*			

*p<0.05; **p<0.01; ***p<0.001*; † reference group for regression analyses*; **Note: χ^2= 34.69, p<0.001**

a= Increase in multinomial logit estimate – females more likely than males to be in this outcome category than not frequently involved in cyberbullying

b= Decrease in multinomial logit estimate - females less likely than males to be in this outcome category than not frequently involved in cyberbullying

In order to maximise power, the less conservative "involvement in cyberbullying" variable which focuses on any involvement over the previous 12 months has been used in the models applied to test study hypotheses as some of the proportions in the more frequent involvement in cyberbullying variable are small.

4.3.2 Cyberbullying involvement and adolescent mental health

This section details the analyses performed on the imputed data to test Hypothesis 3:

> **Hypothesis 3:** It is hypothesised that involvement in cyberbullying at baseline (as a cybervictim, cyberbully or cyberbully-victim) will be associated with poorer mental health (in the form of greater risk of depressive symptoms and social anxiety symptoms, and poorer well-being scores) at follow-up.

These analyses are described first in relation to the baseline cross-sectional data and then using the longitudinal data.

4.3.2.1 Baseline cross-sectional analyses

4.3.2.1.1 Cyberbullying involvement and depressive symptoms

At baseline, odds of reporting depressive symptoms were 2.65 times higher among those who reported being cybervictims compared to their uninvolved peers even after adjusting for gender, ethnicity, SES, and school. In addition, odds of reporting depressive symptoms at baseline were 3.87 times higher among cyberbully-victims compared to uninvolved participants after adjustment for gender, ethnicity, SES, and school. These results are illustrated in Table 33.

Tests of model fit indicate that the unadjusted model, the model adjusted for gender, and the model additionally adjusted for ethnicity, SES, and school, fit the data with at least one parameter in each model not equal to zero. The Wald test comparing Model 2 to the unadjusted model indicates that adding gender to the model improves the fit of the data. The Wald test comparing Model 3 to Model 2 also suggests that additionally adding ethnicity, SES, and school may contribute to further improving the model fit.

Table 33: Cross-sectional analysis – Odds ratios and 95% confidence intervals for the association between cyberbullying and depressive symptoms at baseline

		Model 1			Model 2			Model 3		
SMFQ - baseline	**N**	**OR**	**P-val**	**95% CI**	**OR**	**P-val**	**95% CI**	**OR**	**P-val**	**95% CI**
Not involved in cyberbullying†	1010	1.00	-	-				1.00	-	-
Cybervictim	238	**2.66**	**<0.001**	**[1.97,3.58]**	**2.71**	**<0.001**	**[1.99, 3.68]**	**2.65**	**<0.001**	**[1.94,3.64]**
Cyberbully	143	1.32	0.198	[0.86,2.01]	1.37	0.151	[0.89, 2.11]	1.41	0.128	[0.91,2.20]
Cyberbully-victim	356	**3.44**	**<0.001**	**[2.63,4.50]**	**3.80**	**<0.001**	**[2.89, 5.01]**	**3.87**	**<0.001**	**[2.91,5.14]**
		F	***P-val***		***F***	***P-val***		***F***	***P-val***	
Model fit		*31.61*	*<0.001*		*36.30*	*<0.001*		*4.71*	*<0.001*	
Wald test					*65.06*	*<0.001*		*0.99*	*0.493*	

Model 1: Unadjusted; Model 2: adjusted for gender; Model 3: adjusted for gender, ethnicity, SES, & school (not presented); N refers to the complete record data, models based on imputed data; † reference group for regression analyses

4.3.2.1.2 Cyberbullying involvement and social anxiety symptoms

At baseline there was an 80% increase in odds of reporting social anxiety among cybervictims compared to uninvolved participants. There was still evidence for an association after adjustment for gender, ethnicity, SES, and school with a 77% increase in odds of social anxiety symptoms among cybervictims compared to uninvolved peers after controlling for the effects of these confounders. Similarly, there was a 65% increase in odds of reporting social anxiety symptoms among cyberbully-victims compared to uninvolved peers and this association was sustained after adjustment for gender, ethnicity, SES, and school. These results are illustrated in Table 34.

Tests of model fit indicate that the unadjusted model, the model adjusted for gender, and the model additionally adjusted for ethnicity, SES, and school, fit the data with at least one parameter in each model not equal to zero. The Wald test comparing Model 2 to the unadjusted model indicates that adding gender to the model improves the fit of the data. However, the Wald test comparing Model 3 to Model 2 suggests that additionally adding ethnicity, SES, and school does not contribute to further improving the model fit.

Table 34: Cross-sectional analysis – Odds ratios and 95% confidence intervals for the associations between cyberbullying involvement and social anxiety symptoms at baseline

		Model 1			Model 2			Model 3		
Mini-SPIN - baseline	**N**	**OR**	**P-val**	**95% CI**	**OR**	**P-val**	**95% CI**	**OR**	**P-val**	**95% CI**
Not involved in cyberbullying†	1010	1.00	-	-	1.00	-	-	1.00	-	-
Cybervictim	238	**1.80**	**<0.001**	**[1.35,2.40]**	**1.81**	**<0.001**	**[1.35, 2.42]**	**1.77**	**<0.001**	**[1.31,2.39]**
Cyberbully	143	0.74	0.183	[0.48,1.15]	0.75	0.212	[0.48, 1.18]	0.76	0.234	[0.48,1.19]
Cyberbully-victim	356	**1.65**	**<0.001**	**[1.28,2.13]**	**1.74**	**<0.001**	**[1.34, 2.25]**	**1.74**	**<0.001**	**[1.33,2.28]**
		F	***P-val***		***F***	***P-val***		***F***	***P-val***	
Model fit		*10.02*	*<0.001*		*14.98*	*<0.001*		*2.56*	*<0.001*	
Wald test					*34.37*	*<0.001*		*1.16*	*0.227*	

Model 1: Unadjusted; Model 2: adjusted for gender; Model 3: adjusted for gender, ethnicity, SES, & school (not presented); N refers to the complete record data, models based on imputed data; † reference group for regression analyses

4.3.2.1.3 Cyberbullying involvement and mental well-being

Compared to those uninvolved in cyberbullying, cybervictims reported a 69% increase in risk of reporting below average well-being at baseline and this association was sustained following adjustment for gender, ethnicity, SES, and school with a 74% increased risk of reporting below average well-being at baseline among cybervictims compared to cyberbully-victims in the fully adjusted model. Similarly, risk of reporting below average well-being was 84% higher among cyberbully-victims compared to their uninvolved peers. This association was also sustained following adjustment for gender, ethnicity, SES, and school with a twofold increased risk of reporting below average well-being among cyberbully-victims in the adjusted model.

In contrast, focusing on above average well-being, there was a 43% reduction in risk of reporting above average well-being among cybervictims in the unadjusted and adjusted models. Compared to those uninvolved in cyberbullying, there was a 50% reduction in risk of reporting above average well-being among cyberbully-victims and this association was also sustained in the adjusted models. These results are illustrated in Table 35.

Tests of model fit indicate that the unadjusted model, the model adjusted for gender, and the model additionally adjusted for ethnicity, SES, and school, fit the data with at least one parameter in each model not equal to zero. The Wald test comparing Model 2 to the unadjusted model indicates that adding gender to the model improves the fit of the data. In addition, the Wald test comparing Model 3 to Model 2 suggests that additionally adding ethnicity, SES, and school contributes to further improving the model fit.

Table 35: Cross-sectional analysis – Relative risk ratios and 95% confidence intervals for the association between cyberbullying involvement and mental well-being at baseline

		Below average well-being						**Above average well-being**					
		Model 1		**Model 2**		**Model 3**		**Model 1**		**Model 2**		**Model 3**	
	N	**RRR**	**95%CI**	**RRR**	**95%CI**	**RRR**	**95%CI**	**RRR**	**95%CI**	**RRR**	**95%CI**	**RRR**	**95%CI**
Not involved in cyberbullying†	1010	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-
Cybervictim	238	**1.69****	**[1.20, 2.39]**	**1.70****	**[1.20, 2.40]**	**1.74****	**[1.22, 2.49]**	**0.57****	**[0.37, 0.86]**	**0.57****	**[0.37, 0.86]**	**0.57***	**[0.37, 0.87]**
Cyberbully	143	0.96	[0.58, 1.59]	0.98	[0.59, 1.63]	1.01	[0.60, 1.69]	0.68	[0.42, 1.10]	0.67	[0.41, 1.09]	0.64	[0.39, 1.05]
Cyberbully-victim	356	**1.84*****	**[1.35, 2.50]**	**1.92*****	**[1.41, 2.61]**	**2.02*****	**[1.47, 2.77]**	**0.50****	**[0.33, 0.75]**	**0.48*****	**[0.32, 0.72]**	**0.48****	**[0.31, 0.73]**
								F	***P-val***	***F***	***P-val***	***F***	***P-val***
Model fit								*7.12*	*<0.001*	*8.58*	*<0.001*	*2.36*	*<0.001*
Wald test										*14.65*	*<0.001*	*1.75*	*<0.001*

**p<0.05; **p<0.01; ***p<0.001; Model 1 – Unadjusted; Model 2 – adjusted for gender; Model 3 – adjusted for gender, ethnicity, SES, and school (school not presented); N refers to the complete record data, models based on imputed data; † reference group for regression analyses*

Base outcome: Average well-being (within 1 SD of mean)

4.3.2.2 Longitudinal analyses

4.3.2.2.1 Cyberbullying involvement and depressive symptoms

Results of a series of binomial logistic regression analyses suggested that odds of reporting depressive symptoms at follow-up were higher among cybervictims and cyberbully-victims compared to peers uninvolved in cyberbullying at baseline. Odds of reporting depressive symptoms at follow-up were 96% higher among cybervictims compared to those uninvolved in cyberbullying at baseline. There was still evidence for an association following adjustment for gender, additional adjustment for ethnicity, SES, and school, and further adjustment for baseline depressive symptoms. While the effect was attenuated following adjustment for baseline depressive symptoms, there was still evidence to suggest a 44% increase in odds of reporting depressive symptoms at follow-up among cybervictims compared to their uninvolved peers. In addition, odds of reporting depressive symptoms at follow-up were 2.14 times higher among those who reporting being cyberbully-victims at baseline compared to those uninvolved. Again, though this effect is attenuated slightly in the fully adjusted model, there is still evidence to suggest a 54% increase in odds of reporting depressive symptoms at follow-up among those involved in cyberbullying as cyberbully-victims at baseline. There was no evidence to suggest an increase in odds of depressive symptoms for cyberbullies compared to their uninvolved peers. These results are shown in Table 36.

Tests of model fit indicate that the unadjusted model, the model adjusted for gender, the model additionally adjusted for ethnicity, SES, and school, and the model additionally adjusted for baseline depressive symptoms fit the data with at least one parameter in each model not equal to zero. The Wald test comparing Model 2 to the unadjusted model indicates that adding gender to the model improves the fit of the data. The Wald test comparing Model 3 to Model 2, however, suggests that additionally adding ethnicity, SES, and school may not contribute to further improving the model fit. Adding baseline depressive symptoms to the model improved the model fit.

Table 36: Longitudinal analysis – Odds ratios and 95% confidence intervals for the associations between cyberbullying involvement at baseline and depressive symptoms at follow-up

		Model 1			Model 2			Model 3			Model 4		
	N	**OR**	**P-val**	**95% CI**	**OR**	**P-val**	**95% CI**	**OR**	**P-val**	**95% CI**	**OR**	**P-val**	**95% CI**
Not involved in cyberbullying†	1010	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
Cybervictim	238	**1.96**	**<0.001**	**[1.45,2.67]**	**2.02**	**<0.001**	**[1.47, 2.79]**	**1.95**	**<0.001**	**[1.40,2.71]**	**1.44**	**0.048**	**[1.00,2.06]**
Cyberbully	143	1.21	0.323	[0.83,1.77]	1.28	0.228	[0.86, 1.91]	1.27	0.246	[0.85,1.92]	1.16	0.515	[0.75,1.79]
Cyberbully-victim	356	**2.14**	**<0.001**	**[1.66,2.76]**	**2.46**	**<0.001**	**[1.86, 3.21]**	**2.42**	**<0.001**	**[1.83,3.19]**	**1.54**	**0.006**	**[1.13,2.09]**
		F	***P-val***		***F***	***P-val***		***F***	***P-val***		***F***	***P-val***	
Model fit		*13.74*	*<0.001*		*35.70*	*<0.001*		*5.08*	*<0.001*		*9.36*	*<0.001*	
Wald test					*134.34*	*<0.001*		*1.22*	*0.167*		*239.31*	*<0.001*	

Model 1: Unadjusted; Model 2: adjusted for gender; Model 3: adjusted for gender, ethnicity, SES, & school (not presented); Model 4: Model 3 additionally adjusted for baseline depressive symptoms; N refers to the complete record data, models based on imputed data; † reference group for regression analyses

4.3.2.2.2 Cyberbullying involvement and social anxiety symptoms

Results of binomial logistic regression analyses indicated evidence for an association between cyberbullying involvement at baseline and social anxiety symptoms at follow-up. The odds of reporting social anxiety symptoms at follow-up were 68% greater among cybervictims compared to those uninvolved in cyberbullying in the unadjusted model. Following adjustment for gender, ethnicity, SES, and school there was still evidence for an association with odds of reporting social anxiety symptoms 72% greater among cybervictims compared to those uninvolved in cyberbullying at baseline. After adjustment for baseline social anxiety symptoms the effect was attenuated slightly though there was still evidence for an association between involvement in cyberbullying as a cybervictim at baseline and social anxiety symptoms at follow-up.

Similarly, cyberbully-victims had 52% greater odds of reporting social anxiety symptoms at follow-up compared to their uninvolved peers and there was still evidence for an association following adjustment for gender, ethnicity, SES, school, and baseline social anxiety symptoms. The results did not provide evidence, however, for an association between being a cyberbully at baseline and social anxiety symptoms at follow-up. These results are shown in Table 37.

Tests of model fit indicate that the unadjusted model, the model adjusted for gender, the model additionally adjusted for ethnicity, SES, and school, and the model additionally adjusted for baseline social anxiety symptoms fit the data with at least one parameter in each model not equal to zero. The Wald test comparing Model 2 to the unadjusted model indicates that adding gender to the model improves the fit of the data. The Wald test comparing Model 3 to Model 2, however, suggests that additionally adding ethnicity, SES, and school may not contribute to further improving the model fit. Adding baseline social anxiety symptoms to the model improved the model fit.

Table 37: Longitudinal analysis – Odds ratios and 95% confidence intervals for the association between cyberbullying involvement at baseline and social anxiety symptoms at follow-up

		Model 1			Model 2			Model 3			Model 4		
	N	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**
Not involved in cyberbullying†	1010	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
Cybervictim	238	**1.68**	**<0.001**	**[1.27,2.22]**	**1.68**	**<0.001**	**[1.27, 2.23]**	**1.72**	**<0.001**	**[1.28,2.30]**	**1.52**	**0.009**	**[1.11,2.07]**
Cyberbully	143	0.79	0.240	[0.53,1.17]	0.80	0.281	[0.54, 1.19]	0.80	0.276	[0.53,1.20]	0.85	0.438	[0.55,1.29]
Cyberbully-victim	356	**1.52**	**0.001**	**[1.19,1.94]**	**1.60**	**<0.001**	**[1.25, 2.05]**	**1.63**	**<0.001**	**[1.26,2.10]**	**1.44**	**0.008**	**[1.10,1.89]**
		F	***P-val***		***F***	***P-val***		***F***	***P-val***		***F***	***P-val***	
Model fit		*8.08*	*<0.001*		*15.20*	*<0.001*		*2.85*	*<0.001*		*6.04*	*<0.001*	
Wald test					*42.51*	*<0.001*		*1.44*	*0.418*		*142.00*	*<0.001*	

Model 1: Unadjusted; Model 2: adjusted for gender; Model 3: adjusted for gender, ethnicity, SES, & school (not presented); Model 4: Model 3 additionally adjusted for baseline social anxiety symptoms; N refers to the complete record data, models based on imputed data; † reference group for regression analyses

4.3.2.2.3 Cyberbullying involvement and mental well-being

Results of a multinomial logistic regression suggested longitudinal associations between cyberbullying involvement at baseline and mental well-being at follow-up. Those involved in cyberbullying as cybervictims had a 55% greater risk of reporting below average well-being relative to average well-being compared to their uninvolved peers. There was still evidence for an association after adjusting for gender, ethnicity, SES, and school but the effect was attenuated after additionally adjusting for baseline well-being. No differences were observed between cybervictims and those uninvolved in cyberbullying in terms of their risk of reporting above average relative to average mental well-being.

A similar pattern emerged for cyberbully-victims in relation to reports of below average mental well-being. That is, those who reported involvement in cyberbullying as cyberbully-victims at baseline had a 65% greater risk of reporting below average relative to average well-being at follow-up in the unadjusted model compared to their uninvolved peers. There was still evidence for an association after adjustment for gender, ethnicity, SES, and school. Those who reported being cyberbully-victims at baseline also had a lower risk of reporting above average relative to average mental well-being at follow-up both in the unadjusted model (32% reduction in risk) and the model adjusted for gender, ethnicity, SES, and school (37% reduction in risk). The longitudinal associations between involvement in cyberbullying and mental well-being were attenuated after adjustment for baseline mental well-being. In addition, based on these multinomial logistic regression analyses, there was no evidence to suggest differences in reports of below average or above average mental well-being between cyberbullies and those not involved in cyberbullying. These results are presented in Table 38.

Tests of model fit indicate that the unadjusted model, the model adjusted for gender, the model additionally adjusted for ethnicity, SES, and school, and the model additionally adjusted for baseline mental well-being fit the data with at least one parameter in each model not equal to zero. The Wald test comparing Model 2 to the unadjusted model indicates that adding gender to the model improves the fit of the data. The Wald test comparing Model 3 to Model 2 suggests that additionally adding ethnicity, SES, and school contributes to further improving the model fit. Adding baseline mental well-being to the model also further improved the model fit.

Table 38: Longitudinal analysis – Relative risk ratios and 95% confidence intervals for the association between cyberbullying involvement at baseline and mental well-being at follow-up

		Below average well-being								Above average well-being							
		Model 1		Model 2		Model 3		Model 4		Model 1		Model 2		Model 3		Model 4	
	N	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI
Not involved in cyberbullying †	1010	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-
Cybervictim	238	**1.55***	**[1.09, 2.21]**	**1.56***	**[1.09, 2.23]**	**1.54***	**[1.06, 2.24]**	1.28	[0.86, 1.91]	0.71	[0.49, 1.03]	0.71	[0.49, 1.03]	0.70	[0.48, 1.03]	0.83	[0.55, 1.24]
Cyberbully	143	1.09	[0.63, 1.90]	**1.12**	**[0.64, 1.94]**	1.09	[0.62, 1.92]	1.07	[0.59, 1.93]	0.96	[0.63, 1.48]	0.94	[0.61, 1.45]	0.91	[0.59, 1.42]	1.01	[0.63, 1.62]
Cyberbully-victim	356	**1.65***	**[1.19, 2.28]**	**1.74***	**[1.25, 2.42]**	**1.73***	**[1.23, 2.45]**	1.38	[0.95, 1.99]	**0.68***	**[0.48, 0.96]**	**0.64***	**[0.46, 0.91]**	**0.63***	**[0.44, 0.90]**	0.77	[0.53, 1.13]
										F	***P-val***	***F***	***P-val***	***F***	***P-val***	***F***	***P-val***
Model fit										3.61	0.001	8.97	<0.001	2.22	<0.001	5.07	<0.001
Wald test												29.54	<0.001	1.47	0.005	75.33	<0.001

**p<0.05; **p<0.01; ***p<0.001; Model 1: Unadjusted; Model 2: adjusted for gender; Model 3: adjusted for gender, ethnicity, SES, & school (not presented); Model 4: Model 3 additionally adjusted for baseline well-being*

N refers to the complete record data, models based on imputed data; † reference group for regression analyses

Base outcome: Average well-being (within 1SD of mean)

4.3.2.3 Sensitivity analyses

As part of the measure of negative life events included in the ORiEL questionnaire, there was one item on whether the adolescent had ever been bullied in their life time. Sensitivity analyses were carried out using the "ever bullied" item in an attempt to determine the extent to which associations between cyberbullying involvement and adolescent mental health were sustained after adjusting for this measure of general involvement in bullying. Tables of these results are included in Appendix 6. The following results were obtained from these sensitivity analyses:

Cybervictims had a 95% increase in odds of reporting depressive symptoms at follow-up in the unadjusted model compared to uninvolved peers. There was still evidence for an association in the model additionally adjusted for gender, ethnicity, SES, school, and the "ever bullied" item though the effect was attenuated slightly (to a 59% reduction in odds of reporting depressive symptoms among cybervictims compared to uninvolved peers). However, after additionally adjusting for baseline depressive symptoms this association was attenuated. There was a twofold increase in odds of reporting depressive symptoms among cyberbully-victims in the unadjusted model compared to their uninvolved peers. This association was sustained in the adjusted model and there was still evidence for an association in the model additionally adjusted for baseline depressive symptoms with a 44% increase in odds of reporting depressive symptoms among cyberbully-victims.

There was a 68% increase in odds of reporting social anxiety symptoms at follow-up among cybervictims compared to those uninvolved in cyberbullying. This association was sustained in the adjusted model though was attenuated following adjustment for baseline social anxiety symptoms. There was also a 52% increase in odds of reporting social anxiety symptoms at follow-up among cyberbully-victims compared to those uninvolved in cyberbullying at baseline. This association was sustained in the adjusted model and the model additionally adjusted for baseline depressive symptoms.

Cybervictims were at a 55% greater risk of reporting below average well-being at follow-up in the unadjusted model compared to their uninvolved peers. However, though this association was attenuated after adjusting for gender, ethnicity, SES, school, and the "ever bullied" item. Cyberbully-victims also had a 65% greater risk of reporting below average well-being at follow-up compared to their uninvolved peers. This

association was sustained after adjustment for gender, ethnicity, SES, school, and the "ever bullied" item but was attenuated after additionally adjusting for baseline well-being.

These sensitivity analyses suggest that the association between involvement in cyberbullying as a cyberbully-victim and adolescent depressive symptoms, social anxiety symptoms and mental well-being remain similar to the main analyses even after adjusting for the "ever bullied" item and baseline mental health. Notably, the association of being a cybervictim with depressive symptoms and social anxiety symptoms is sustained after adjusting for the study covariates and the "ever bullied" item. This suggests that this "ever bullied" item doesn't fully explain the association between cyberbullying involvement and mental health. The associations with depressive symptoms were sustained after adjusting for baseline depressive symptoms but additionally adjusting for baseline social anxiety symptoms and mental well-being the social anxiety and mental well-being models were attenuated.

This "ever bullied" item was the only measure of traditional victimisation available in the ORiEL study and it had a number of limitations. A single item measure of bullying gives little information about the adolescent's involvement in bullying. First, the item asks about any experience of bullying across the life span which is a very long time frame and is not comparable to the 12 month time frame used in the cyberbullying measure. Second, the measure asks the adolescent whether they were "ever bullied" and does not specify a particular type of bullying so adolescents may be referring to physical or relational forms of bullying, or may be including instances of cyberbullying in their response. As cyberbullying victimisation may be included in responses to this measure, adjusting for this item may represent an over adjustment. Third, the single item only refers to whether the adolescent was ever bullied; there is no information about perpetration of bullying. Fourth, this item uses the term "bullying" which was not used in the cyberbullying measure so the measures are not directly comparable in that respect. Though the item is limited, these sensitivity analyses suggest that this single item does not wholly explain the association between involvement in cyberbullying and adolescent mental health.

4.4 Online Network Characteristics and Adolescent Mental Health

This section focuses on describing the characteristics of adolescents' online networks in terms of the number of contacts they have online and whether or not they communicate with strangers. Hypotheses relating to associations between online network characteristics and adolescent mental health are also tested.

4.4.1 Network size

Participants reported on the size of their network on the social networking site they used most. This referred to the number of friends users had on Facebook or the number of followers they had on Twitter or Instagram. The results did not suggest evidence for gender difference in adolescents' online network size at baseline. Based on the figures presented in Table 39 below, 13.2% reported not having their own SNS profile. At baseline, aged 12-13 years, the majority (34.3%) of participants reported having up to 100 friends on their most used SNS. A further 31.1% reported having 101-300 friends while 21.4% reported having over 300 friends.

Table 39: Network size at baseline

		Does not have own profile	Up to 100 friends†	101-300 friends	300+ friends	Total
Male†	**N**	127	346	310	195	978
	%	*13.0*	*35.4*	*31.7*	*20.0*	*100.0*
Female	**N**	105	258	237	181	781
	%	*13.4*	*33.0*	*30.4*	*23.2*	*100.0*
Total	**N**	232	604	547	376	1,759
	%	*13.2*	*34.3*	*31.1*	*21.4*	*100.0*
Model fit		*F=0.57*	*P=0.634*			

*p<0.05; **p<0.01; ***p<0.001*; † reference group for regression analyses*; **Note: χ^2= 3.15, p=0.369; *regression analyses did not provide evidence for an association***

4.4.2 Online communication with strangers

Participants were asked whether they had communicated online with someone they did not know in person over the past 12 months and whether they had shared personal information online with someone they didn't know in person. Participants who answered "yes" to either question were coded as having communicated online with strangers in the past year. Overall, as shown in Table 40, 24.7% of participants who completed this item reported communicating with strangers online in the past 12 months. There was a 21% reduction in odds of reporting communication with strangers online among females compared to males (OR=0.79, 95% CI [0.65, 0.97]) with 21.5% of females communicating with strangers online compared to 27.4% of males.

Table 40: Communication with strangers online at baseline

		Did not communicate online with strangers†	Communicated online with strangers	Total
Male†	**N**	678	256	934
	%	*72.6*	*27.4*	*100*
Female	**N**	606	**166[b*]**	772
	%	*78.5*	*21.5*	*100*
Total	**N**	1,284	422	1,706
	%	*75.3*	*24.7*	*100*
Model fit		*F=5.21*	*P=0.023*	

*p<0.05; **p<0.01; ***p<0.001*; † reference group for regression analyses*; **Note: χ^2= 7.92, p=0.005**

a= Increased odds of communication with strangers for females compared to males

b= Decreased odds of communication with strangers for females compared to males

4.4.3 Network size and adolescent mental health

This section details analyses performed on the imputed data to test Hypothesis 4:

Hypothesis 4: It is hypothesised that those who have very high numbers of friends online at baseline will report better mental health (in the form of lower odds of depressive symptoms and social anxiety symptoms, and lower risk of below average well-being) at follow-up compared to those with average sized networks of online friends.

These analyses are described first in relation to the baseline cross-sectional and then using the longitudinal data.

4.4.3.1 Baseline cross-sectional analyses

4.4.3.1.1 Network size and depressive symptoms

Odds of reporting depressive symptoms at baseline were 50% greater among those with over 300 friends on their most used SNS compared to those with up to 100 friends. This association was sustained following adjustment for gender, ethnicity, SES, and school. These findings are illustrated in Table 41.

Tests of model fit indicate that the unadjusted model, the model adjusted for gender, and the model additionally adjusted for ethnicity, SES, and school, fit the data with at least one parameter in each model not equal to zero. The Wald test comparing Model 2 to the unadjusted model indicates that adding gender to the model improves the

fit of the data. The Wald test comparing Model 3 to Model 2, however, suggests that additionally adding ethnicity, SES, and school may not contribute to further improving the model fit.

Table 41: Cross-sectional analysis – Odds ratios and 95% confidence intervals for the association between network size and depressive symptoms at baseline

		Model 1			Model 2			Model 3		
SMFQ - baseline	**N**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**
Does not have own profile	232	0.86	0.427	[0.60,1.25]	0.85	0.389	[0.58, 1.23]	0.85	0.399	[0.58,1.24]
Up to 100 friends†	604	1.00	-	-	1.00	-	-	1.00	-	-
101-300 friends	547	0.96	0.771	[0.73,1.26]	0.96	0.794	[0.73, 1.27]	0.98	0.906	[0.74,1.31]
300+ friends	376	**1.50**	**0.003**	**[1.15,1.95]**	**1.48**	**0.005**	[1.13, 1.93]	**1.52**	**0.003**	**[1.15,2.01]**
		F	***P-val***		***F***	***P-val***		***F***	***P-val***	
Model fit		*4.56*	*0.003*		*15.21*	*<0.001*		*2.63*	*<0.001*	
Wald test					*54.77*	*<0.001*		*1.16*	*0.234*	

Model 1: Unadjusted; Model 2: adjusted for gender: Model 3: adjusted for gender, ethnicity, SES, & school (not presented); N refers to the complete record data, models based on imputed data; † reference group for regression analyses

4.4.3.1.2 Network size and social anxiety symptoms

The results of this study did not suggest evidence for a cross-sectional association between adolescents' online network size on their most used SNS at baseline and baseline symptoms of social anxiety. These results are shown in Table 42.

Tests of model fit indicate that the unadjusted model does not fit the data better than a model which includes only the intercept. The model adjusted for gender, and the model additionally adjusted for ethnicity, SES, and school did fit the data with at least one parameter in each model not equal to zero. The Wald test comparing Model 2 to the unadjusted model indicates that adding gender to the model improves the fit of the data. The Wald test comparing Model 3 to Model 2, however, suggests that additionally adding ethnicity, SES, and school may not contribute to further improving the model fit.

Table 42: Cross-sectional analysis – Odds ratios and 95% confidence intervals for the association between network size and social anxiety symptoms at baseline

		Model 1			Model 2			Model 3		
mini SPIN - baseline	**N**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**
Does not have own profile	232	0.87	0.454	[0.62,1.24]	0.87	0.426	[0.61,1.24]	0.88	0.478	[0.61,1.26]
Up to 100 friends†	604	1.00	-	-	1.00	-	-	1.00	-	-
101-300 friends	547	0.93	0.594	[0.72,1.21]	0.93	0.609	[0.72,1.21]	0.91	0.487	[0.69,1.19]
300+ friends	376	0.95	0.746	[0.72,1.27]	0.94	0.652	[0.70,1.24]	0.91	0.521	[0.67,1.22]
		F	***P-val***		***F***	***P-val***		***F***	***P-val***	
Model fit		*0.24*	*0.867*		*7.29*	*<0.001*		*1.86*	*<0.001*	
Wald test					*33.13*	*<0.001*		*1.25*	*0.143*	

Model 1: Unadjusted; Model 2: adjusted for gender; Model 3: adjusted for gender, ethnicity, SES, & school (not presented); N refers to the complete record data, models based on imputed data; † reference group for regression analyses

4.4.3.1.3 Network size and well-being

Results of a multinomial logistic regression of well-being on network size did not suggest evidence for an association between the size of adolescents' contact networks online and their well-being either in the unadjusted or adjusted models, as shown in Table 43.

Tests of model fit indicate that the unadjusted model does not fit the data better than a model which includes only the intercept. The model adjusted for gender, and the model additionally adjusted for ethnicity, SES, and school did fit the data with at least one parameter in each model not equal to zero. The Wald test comparing Model 2 to the unadjusted model indicates that adding gender to the model improves the fit of the data. The Wald test comparing Model 3 to Model 2 also suggests that additionally adding ethnicity, SES, and school may contribute to further improving the model fit.

Table 43: Cross-sectional analysis – Relative risk ratios and 95% confidence intervals for the association between network size and well-being at baseline

		Below average well-being						Above average well-being					
		Model 1		Model 2		Model 3		Model 1		Model 2		Model 3	
	N	RRR	95% CI	RRR	95%CI	RRR	95%CI	RRR	95%CI	RRR	95%CI	RRR	95%CI
Does not have own profile	232	1.32	[0.90, 1.93]	1.31	[0.89, 1.92]	1.31	[0.88, 1.96]	1.02	[0.67, 1.55]	1.02	[0.67, 1.56]	1.03	[0.66, 1.59]
Up to 100 friends†	604	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-
101-300 friends	547	0.94	[0.68, 1.30]	0.94	[0.68, 1.31]	0.94	[0.67, 1.32]	1.13	[0.82, 1.56]	1.13	[0.82, 1.56]	1.19	[0.85, 1.67]
300+ friends	376	1.10	[0.77, 1.56]	1.08	[0.76, 1.54]	1.18	[0.82, 1.71]	1.30	[0.93, 1.82]	1.32	[0.94, 1.85]	1.31	[0.92, 1.85]
								F	***P-val***	***F***	***P-val***	***F***	***P-val***
Model fit								*0.99*	*0.429*	*3.67*	*<0.001*	*1.90*	*<0.001*
Wald test										*13.11*	*<0.001*	*1.74*	*<0.001*

Model 1: Unadjusted; Model 2: adjusted for gender; Model 3: adjusted for gender, ethnicity, SES, & school (not presented); N refers to complete record data, models based on imputation;

Base outcome: Average well-being (within 1SD of mean); † reference group for regression analyses

4.4.3.2 Longitudinal analyses

4.4.3.2.1 Network size and depressive symptoms

A binary logistic regression was carried out regressing SMFQ (depressive symptoms) at follow-up on network size. Results of this analysis suggested a 34% increase in odds of reporting depressive symptoms at follow-up among those with over 300 friends on their most used SNS compared to those with up to 100 friends. This association was attenuated, however, following adjustment for gender and the results do not suggest evidence for a longitudinal association between network size at baseline and depressive symptoms at follow-up after accounting for gender, ethnicity, SES, school, and baseline depressive symptoms. These results are shown in Table 44.

Tests of model fit indicate that the unadjusted model may not fit the data better than a model which includes only the intercept. The model adjusted for gender, the model additionally adjusted for ethnicity, SES, and school, and the model additionally adjusted for baseline depressive symptoms did fit the data with at least one parameter in each model not equal to zero. The Wald test comparing Model 2 to the unadjusted model indicates that adding gender to the model improves the fit of the data. The Wald test comparing Model 3 to Model 2, however, suggests that additionally adding ethnicity, SES, and school may not contribute to further improving the model fit. Further adjustment for baseline depressive symptoms, however, does contribute to improving the model fit.

Table 44: Longitudinal analysis – Odds ratios and 95% confidence intervals for the association between network size at baseline and depressive symptoms at follow-up

		Model 1			Model 2			Model 3			Model 4		
SMFQ - follow-up	**N**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**
Does not have own profile	232	0.98	0.883	[0.71,1.34]	0.96	0.802	[0.69,1.33]	0.98	0.922	[0.71,1.37]	1.05	0.792	[0.73,1.51]
Up to 100 friends†	604	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
101-300 friends	547	0.93	0.575	[0.72,1.20]	0.93	0.601	[0.71,1.22]	0.93	0.589	[0.70,1.22]	0.92	0.568	[0.68,1.24]
300+ friends	376	**1.34**	**0.037**	**[1.02,1.77]**	1.32	0.058	[0.99,1.76]	1.31	0.080	[0.97,1.76]	1.13	0.479	[0.81,1.57]
		F	***P-val***		***F***	***P-val***		***F***	***P-val***		***F***	***P-val***	
Model fit		*2.56*	*0.053*		*29.14*	*<0.001*		*4.25*	*<0.001*		*9.34*	*<0.001*	
Wald test					*126.82*	*<0.001*		*1.38*	*0.064*		*275.36*	*<0.001*	

Model 1: Unadjusted; Model 2: adjusted for gender; Model 3: adjusted for gender, ethnicity, SES, & school (not presented); Model 4: Model 3 additionally adjusted for baseline depressive symptoms; N refers to the complete record data, models based on imputed data; † reference group for regression analyses

4.4.3.2.2 Network size and social anxiety symptoms

Similar to the baseline findings, the results did not provide evidence for an association between online network size at baseline and social anxiety symptoms at follow-up in the unadjusted or adjusted longitudinal logistic regression models, as illustrated in Table 45.

Tests of model fit indicate that the unadjusted model does not fit the data better than a model which includes only the intercept. The model adjusted for gender, the model additionally adjusted for ethnicity, SES, and school, and the model additionally adjusted for baseline social anxiety symptoms did fit the data with at least one parameter not equal to zero. The Wald test comparing Model 2 to the unadjusted model indicates that adding gender to the model improves the fit of the data. The Wald test comparing Model 3 to Model 2 also suggests that additionally adding ethnicity, SES, and school may contribute to further improving the model fit. In addition, further adjustment for baseline social anxiety symptoms contributes to improving the model fit.

Table 45: Longitudinal analysis – Odds ratios and 95% confidence intervals for the association between network size at baseline and social anxiety symptoms at follow-up

		Model 1			Model 2			Model 3			Model 4		
mini SPIN - follow-up	**N**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**
Does not have own profile	232	0.82	0.252	[0.58,1.15]	0.81	0.226	[0.57,1.14]	0.78	0.174	[0.55,1.12]	0.79	0.213	[0.55,1.14]
Up to 100 friends†	604	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
101-300 friends	547	1.10	0.430	[0.87,1.40]	1.11	0.408	[0.87,1.41]	1.13	0.347	[0.88,1.45]	1.17	0.247	[0.90,1.52]
300+ friends	376	1.00	0.998	[0.76,1.31]	0.98	0.892	[0.75,1.29]	0.97	0.827	[0.73,1.28]	0.99	0.963	[0.73,1.34]
		F	***P-val***		***F***	***P-val***		***F***	***P-val***		***F***	***P-val***	
Model fit		*0.96*	*0.412*		*9.28*	*<0.001*		*2.30*	*<0.001*		*5.85*	*<0.001*	
Wald test					*41.37*	*<0.001*		*1.46*	*0.035*		*154.85*	*<0.001*	

Model 1: Unadjusted; Model 2: adjusted for gender; Model 3: Adjusted for gender, ethnicity, SES, & school (not presented); Model 4: Model 3 adjusted for baseline social anxiety symptoms; N refers to the complete record data, models based on imputed data; † reference group for regression analyses

4.4.3.2.3 Network size and well-being

The results did not provide evidence of an association between online network size at baseline and adolescents' self-reported mental well-being at follow-up. These results are shown in Table 46.

Tests of model fit indicate that the unadjusted model does not fit the data better than a model which includes only the intercept. The model adjusted for gender, the model additionally adjusted for ethnicity, SES, and school, and the model additionally adjusted for baseline mental well-being did fit the data with at least one parameter not equal to zero. The Wald test comparing Model 2 to the unadjusted model indicates that adding gender to the model improves the fit of the data. The Wald test comparing Model 3 to Model 2 also suggests that additionally adding ethnicity, SES, and school may contribute to further improving the model fit. In addition, further adjustment for baseline mental well-being contributes to improving the model fit.

Table 46: Longitudinal analysis – Relative risk ratios and 95% confidence intervals for the association between network size at baseline and well-being at follow-up

		Below average well-being								Above average well-being							
		Model 1		Model 2		Model 3		Model 4		Model 1		Model 2		Model 3		Model 4	
	N	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI
Does not have own profile	232	1.01	[0.66, 1.55]	1.00	[0.65, 1.54]	0.98	[0.63, 1.53]	0.85	[0.53, 1.38]	1.20	[0.80, 1.79]	1.21	[0.81, 1.81]	1.17	[0.77, 1.77]	1.22	[0.79, 1.89]
Up to 100 friends†	604	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-
101-300 friends	547	0.89	[0.64, 1.25]	0.90	[0.64, 1.25]	0.89	[0.63, 1.26]	0.90	[0.62, 1.30]	1.07	[0.78, 1.46]	1.07	[0.78, 1.46]	1.06	[0.77, 1.48]	1.01	[0.72, 1.43]
300+ friends	376	1.24	[0.88, 1.75]	1.22	[0.86, 1.73]	1.24	[0.87, 1.78]	1.22	[0.82, 1.81]	1.29	[0.94, 1.79]	1.32	[0.95, 1.83]	1.31	[0.93, 1.83]	1.24	[0.87, 1.77]
										F	***P-val***	***F***	***P-val***	***F***	***P-val***	***F***	***P-val***
Model fit										0.86	0.520	6.82	<0.001	2.01	<0.001	5.08	<0.001
Wald test												28.04	<0.001	1.48	0.005	79.34	<0.001

Model 1: Unadjusted; Model 2: adjusted for gender; Model 3: adjusted for gender, ethnicity, SES, & school (not presented); Model 4: Model 3 additionally adjusted for baseline well-being; N refers to the complete record data, models based on imputed data
Base outcome: Average well-being (within 1SD of mean); † reference group for regression analyses

4.4.4 Online communication with strangers and adolescent mental health

This section details analyses performed on the imputed data to test Hypothesis 5:

Hypothesis 5: It is hypothesised that those who report communicating with strangers online at baseline will report with poorer mental health (in the form of greater odds of depressive symptoms and social anxiety symptoms, and increased risk of below average well-being) at follow-up.

These analyses are described first in relation to the baseline cross-sectional and then using the longitudinal data.

4.4.4.1 Baseline cross-sectional analyses

4.4.4.1.1 Online communication with strangers and depressive symptoms

Those who reported communicating with strangers over the past 12 months had greater odds of reporting symptoms of depression at baseline than their peers who did not communicate with strangers. Results of a binary logistic regression indicated a 69% increase in odds of reporting depressive symptoms among those who communicated with strangers online compared to those who did not. This association was sustained following adjustment for gender, ethnicity, SES, and school with a 77% increase in odds of reporting depressive symptoms among those who communicated with strangers compared to those who did not. Table 47 illustrates these results.

Tests of model fit indicate that the unadjusted model, the model adjusted for gender, and the model additionally adjusted for ethnicity, SES, and school fit the data with at least one parameter not equal to zero. The Wald test comparing Model 2 to the unadjusted model indicates that adding gender to the model improves the fit of the data. However, the Wald test comparing Model 3 to Model 2 suggests that additionally adding ethnicity, SES, and school does not contribute to further improving the model fit.

Table 47: Cross-sectional analysis – Odds ratios and 95% confidence intervals for the association between online communication with strangers and depressive symptoms at baseline

		Model 1			Model 2			Model 3		
SMFQ - baseline	**N**	**OR**	**P-val**	**95% CI**	**OR**	**P-val**	**95% CI**	**OR**	**P-val**	**95% CI**
Does not communicate with strangers online†	1234	1.00	-	-	1.00	-	-	1.00	-	-
Communicates with strangers online	422	**1.69**	**<0.001**	**[1.32,2.15]**	**1.80**	**<0.001**	**[1.40,2.31]**	**1.77**	**<0.001**	**[1.37,2.29]**
		F	***P-val***		***F***	***P-val***		***F***	***P-val***	
Model fit		*18.01*	*<0.001*		*34.85*	*<0.001*		*3.00*	*<0.001*	
Wald test					*59.81*	*<0.001*		*1.08*	*0.340*	

Model 1: Unadjusted; Model 2: adjusted for gender; Model 3: adjusted for gender, ethnicity, SES, & school (not presented); N refers to the complete record data, models based on imputed data; † reference group for regression analyses

4.4.4.1.2 Online communication with strangers and social anxiety symptoms

Communication with strangers online was also associated with symptoms of social anxiety at baseline. There was a 45% increase in odds of reporting depressive symptoms at baseline among those who reported communicating with strangers online. This association was sustained following adjustment for gender, ethnicity, SES, and school. These results are shown in Table 48.

Tests of model fit indicate that the unadjusted model, the model adjusted for gender, and the model additionally adjusted for ethnicity, SES, and school fit the data with at least one parameter not equal to zero. The Wald test comparing Model 2 to the unadjusted model indicates that adding gender to the model improves the fit of the data. However, the Wald test comparing Model 3 to Model 2 suggests that additionally adding ethnicity, SES, and school does not contribute to further improving the model fit.

Table 48: Cross-sectional analysis – Odds ratios and 95% confidence intervals for the association between online communication with strangers and social anxiety symptoms at baseline

		Model 1			Model 2			Model 3		
mini SPIN - baseline	**N**	**OR**	**P-val**	**95% CI**	**OR**	**P-val**	**95% CI**	**OR**	**P-val**	**95% CI**
Does not communicate with strangers online†	1234	1.00	-	-	1.00	-	-	1.00	-	-
Communicates with strangers online	422	**1.45**	**0.001**	**[1.15,1.81]**	**1.51**	**<0.001**	**[1.20,1.89]**	**1.52**	**<0.001**	**[1.21,1.92]**
		F	***P-val***		***F***	***P-val***		***F***	***P-val***	
Model fit		*10.35*	*0.001*		*21.74*	*<0.001*		*2.27*	*<0.001*	
Wald test					*35.50*	*<0.001*		*1.24*	*0.149*	

Model 1: Unadjusted; Model 2: adjusted for gender; Model 3: adjusted for gender, ethnicity, SES, & school (not presented); N refers to the complete record data, models based on imputed data; † reference group for regression analyses

4.4.4.1.3 Online communication with strangers and well-being

Those who communicated with strangers online had a 37% greater risk of reporting below average well-being compared to those who did not communicate with strangers online in the unadjusted model. This association was sustained in the model adjusted for gender, ethnicity, SES, and school with a 48% greater risk of reporting below average well-being among those who communicated online with strangers compared to those who did not. These findings are shown in Table 49.

Tests of model fit indicate that the unadjusted model does not fit the data better than a model with only the intercept. The model adjusted for gender, and the model additionally adjusted for ethnicity, SES, and school fit the data with at least one parameter not equal to zero. The Wald test comparing Model 2 to the unadjusted model indicates that adding gender to the model improves the fit of the data. In addition, the Wald test comparing Model 3 to Model 2 suggests that additionally adding ethnicity, SES, and school contributes to further improving the model fit.

Table 49: Cross-sectional analysis – Relative risk ratios and 95% confidence intervals for the association between online communication with strangers and well-being at baseline

		Below average well-being						**Above average well-being**					
		Model 1		**Model 2**		**Model 3**		**Model 1**		**Model 2**		**Model 3**	
	N	**RRR**	**95% CI**	**RRR**	**95%CI**	**RRR**	**95%CI**	**RRR**	**95%CI**	**RRR**	**95%CI**	**RRR**	**95%CI**
Does not communicate with strangers online†	1234	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-
Communicates with strangers online	422	**1.37***	**[1.03, 1.83]**	**1.42***	**[1.06, 1.89]**	**1.48***	**[1.10, 2.00]**	0.88	[0.65, 1.20]	0.86	[0.63, 1.17]	0.85	[0.62, 1.16]
								F	***P-val***	***F***	***P-val***	***F***	***P-val***
Model fit								*3.23*	*0.400*	*7.95*	*<0.001*	*2.05*	*<0.001*
Wald test										*13.89*	*<0.001*	*1.79*	*<0.001*

Model 1: Unadjusted; Model 2: adjusted for gender; Model 3: adjusted for gender, ethnicity, SES, & school (not presented); N refers to complete record data, models based on imputed data; Base outcome: Average well-being (within 1SD of mean); † reference group for regression analyses

4.4.4.2 Longitudinal analyses

4.4.4.2.1 Online communication with strangers and depressive symptoms

A series of binary logistic regression models were fitted to the data to examine the longitudinal association between communication with strangers at baseline and depressive symptoms at follow-up. Results of these analyses indicated that those who communicated with strangers at baseline had a 49% increase in odds of reporting depressive symptoms at follow-up compared to those who did not communicate with strangers online. This association was sustained following adjustment for gender, ethnicity, SES, and school with a 60% increase in odds of reporting depressive symptoms among those who communicated with strangers online. There was also still evidence for an association between online communication with strangers at baseline and depressive symptoms at follow-up following additional adjustment for baseline depressive symptoms with a 35% increase in odds of reporting depressive symptoms at follow-up among those who reported communicating with strangers online at baseline. These results are illustrated in Table 50.

Tests of model fit indicate that the unadjusted model, the model adjusted for gender, the model additionally adjusted for ethnicity, SES, and school, and the model additionally adjusted for baseline depressive symptoms did fit the data with at least one parameter in each model not equal to zero. The Wald test comparing Model 2 to the unadjusted model indicates that adding gender to the model improves the fit of the data. The Wald test comparing Model 3 to Model 2, however, suggests that additionally adding ethnicity, SES, and school may not contribute to further improving the model fit. Further adjustment for baseline depressive symptoms, however, does contribute to improving the model fit.

Table 50: Longitudinal analysis – Odds ratios and 95% confidence intervals for the association between online communication with strangers at baseline and depressive symptoms at follow-up

		Model 1			Model 2			Model 3			Model 4		
SMFQ - follow-up	**N**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**
Does not communicate with strangers online†	1234	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
Communicates with strangers online	422	**1.49**	**0.001**	**[1.19,1.87]**	**1.64**	**<0.001**	**[1.30,2.08]**	**1.60**	**<0.001**	**[1.26,2.04]**	**1.35**	**0.026**	**[1.04,1.76]**
		F	***P-val***		***F***	***P-val***		***F***	***P-val***		***F***	***P-val***	
Model fit		*12.18*	*<0.001*		*64.12*	*<0.001*		*4.72*	*<0.001*		*9.92*	*<0.001*	
Wald test					*133.37*	*<0.001*		*1.32*	*0.089*		*268.60*	*<0.001*	

Model 1: Unadjusted; Model 2: adjusted for gender; Model 3: adjusted for gender, ethnicity, SES, & school (not presented); Model 4: Model 3 additionally adjusted for baseline depressive symptoms; N refers to complete record data, models based on imputed data; † reference group for regression analyses

4.4.4.2.2 Online communication with strangers and social anxiety symptoms

As shown in Table 51, online communication with strangers at baseline was also associated with social anxiety symptoms at follow-up. Odds of reporting social anxiety symptoms at follow-up were 27% greater among those who communicated with strangers online compared to those who did not. This association was sustained following adjustment for gender, ethnicity, SES, and school. However, the association between online communication with strangers at baseline and social anxiety symptoms at follow-up was attenuated following adjustment for baseline symptoms of social anxiety.

Tests of model fit indicate that the unadjusted model, the model adjusted for gender, the model additionally adjusted for ethnicity, SES, and school, and the model additionally adjusted for baseline social anxiety symptoms did fit the data with at least one parameter in each model not equal to zero. The Wald test comparing Model 2 to the unadjusted model indicates that adding gender to the model improves the fit of the data. The Wald test comparing Model 3 to Model 2 also suggests that additionally adding ethnicity, SES, and school contributes to further improving the model fit. In addition, further adjustment for baseline social anxiety symptoms, also contributes to improving the model fit.

Table 51: Longitudinal analysis – Odds ratios and 95% confidence intervals for the association between online communication with strangers at baseline and social anxiety symptoms at follow-up

		Model 1			Model 2			Model 3			Model 4		
mini SPIN - follow-up	**N**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**
Does not communicate with strangers online†	1234	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
Communicates with strangers online	422	**1.27**	**0.039**	**[1.01,1.60]**	**1.33**	**0.017**	**[1.05, 1.67]**	**1.35**	**0.015**	**[1.06,1.71]**	1.22	0.119	[0.95,1.57]
		F	***P-val***		***F***	***P-val***		***F***	***P-val***		***F***	***P-val***	
Model fit		*4.27*	*0.039*		*20.64*	*<0.001*		*2.50*	*<0.001*		*6.19*	*<0.001*	
Wald test					*62.60*	*<0.001*		*1.44*	*0.040*		*150.08*	*<0.001*	

Model 1: Unadjusted; Model 2: adjusted for gender; Model 3: adj. for gender, ethnicity, SES, & school (not presented); Model 4: Model 3 adj. for baseline social anxiety; N refers to complete record data, models based on imputed data; † reference group for regression analyses

4.4.4.2.3 Online communication with strangers and well-being

Compared to those who did not communicate with strangers online at baseline, those who communicated online with strangers had a 38% greater risk of reporting below average than average well-being at follow-up in the unadjusted model. This association was sustained following adjustment for gender, ethnicity, SES, and school. However, the association between communication with strangers online at baseline and mental well-being at follow-up was attenuated following additional adjustment for baseline mental well-being. These results are illustrated in Table 52.

Tests of model fit provide some evidence to suggest that the unadjusted model may fit the data better than a model which includes only the intercept. The model adjusted for gender, the model additionally adjusted for ethnicity, SES, and school, and the model additionally adjusted for baseline mental well-being fit the data with at least one parameter not equal to zero. The Wald test comparing Model 2 to the unadjusted model indicates that adding gender to the model improves the fit of the data. The Wald test comparing Model 3 to Model 2 also suggests that additionally adding ethnicity, SES, and school may contribute to further improving the model fit. In addition, further adjustment for baseline mental well-being contributes to improving the model fit.

Table 52: Longitudinal analysis – Relative risk ratios and 95% confidence intervals for the association between online communication with strangers at baseline and well-being at follow-up

		Below average well-being								Above average well-being							
		Model 1		Model 2		Model 3		Model 4		Model 1		Model 2		Model 3		Model 4	
	N	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI
Does not communicate with strangers online†	1234	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-
Communicates with strangers online	422	**1.38***	**[1.02, 1.85]**	**1.43***	**[1.06, 1.93]**	**1.42***	**[1.04, 1.93]**	1.26	[0.91, 1.76]	0.89	[0.66, 1.21]	0.86	[0.63, 1.16]	0.86	[0.63, 1.17]	0.89	[0.64, 1.23]
										F	***P-val***	***F***	***P-val***	***F***	***P-val***	***F***	***P-val***
Model fit										2.88	0.056	14.09	<0.001	2.15	<0.001	5.35	<0.001
Wald test												29.11	<0.001	1.48	0.005	59.73	<0.001

Model 1: Unadjusted; Model 2: adjusted for gender; Model 3: adjusted for gender, ethnicity, SES, & school (not presented); Model 4: Model 3 additionally adjusted for baseline well-being; N refers to complete record data, models based on imputed data; Base outcome: Average well-being (within 1SD of mean); † reference group for regression analyses

4.5 Complete Record Analyses

Main analyses examining the hypotheses were also carried out on the complete record data. The results of the complete record analyses were similar to the imputed analyses and are included in Appendix 5 for reference purposes. The imputed results and complete record results are compared below for the main effects obtained for this study – the longitudinal associations between IM use and below average well-being; the longitudinal associations between involvement in cyberbullying and depressive symptoms, social anxiety symptoms, and below-average well-being; and the longitudinal association between online communication with strangers and depressive symptoms, social anxiety symptoms, and below average well-being.

Based on the imputed analyses, those who used IM several times a day at baseline had greater risk of reporting below average well-being than average well-being at follow-up compared to their peers who used IM every day or almost every day after adjusting for gender, ethnicity, SES, school, and baseline well-being (RRR=1.45, 95% CI [1.02, 2.06]). The results of the complete record analyses also indicated an association between using IM several times a day at baseline and reporting below average well-being at follow-up (RRR=1.66, 95% CI [1.13, 2.44]).

The imputed analyses presented in this chapter indicated that those who reported being involved in cyberbullying at baseline either as cybervictims (OR=1.44, 95% CI [1.00, 2.06]) or cyberbully-victims (OR=1.54, 95% CI [1.13, 2.09]) had increased odds of reporting depressive symptoms at follow-up after adjusting for gender, ethnicity, SES, school, and baseline depressive symptoms compared to their uninvolved peers. The results of the complete record analyses were similar as cybervictims (OR=1.47, 95% CI [1.01, 2.14]) and cyberbully-victims (OR=1.59, 95% CI [1.12, 2.25]) had increased odds of reporting depressive symptoms at follow-up after adjustment for gender, ethnicity, SES, and baseline depressive symptoms compared to their uninvolved peers.

Based on the imputed analyses, those who reported being involved in cyberbullying at baseline either as cybervictims (OR=1.52, 95% CI [1.11, 2.07]) or cyberbully-victims (1.44, 95% CI [1.10, 1.89]) had an increase in odds of reporting social anxiety symptoms at follow-up after adjusting for gender, ethnicity, SES, school, and baseline social anxiety symptoms compared to their uninvolved peers. The results of the adjusted complete record analyses were similar as cybervictims (OR=1.76, 95%

CI [1.25, 2.49]) and cyberbully-victims (OR=1.52, 95% CI [1.29, 2.36]) had increased odds of reporting social anxiety symptoms at follow-up compared to their uninvolved peers.

In the imputed analyses, cybervictims (RRR=1.54, 95% CI [1.06, 2.24]) and cyberbully-victims (RRR=1.73, 95% CI 1.23, 2.45]) had increased odds of reporting below average well-being than average well-being compared to their peers who were uninvolved in cyberbullying after adjusting for gender, ethnicity, SES, and school but this association was attenuated after additionally adjusting for baseline mental well-being. Similar results were obtained in the complete record analyses wherein cybervictims (RRR=1.72, 95% CI [1.13, 2.62]) and cyberbully-victims (RRR=1.72, 95% CI [1.18, 2.50]) had increased odds of reporting below-average well-being than their peers uninvolved in cyberbullying after adjusting for gender, ethnicity, SES, and school. Similar to the imputed findings, the association was attenuated in the complete record data after additionally adjusting for baseline well-being.

Those who reported communicating online with strangers at baseline had greater odds of reporting depressive symptoms at follow-up after adjusting for gender, ethnicity, SES, school and baseline depressive symptoms (OR=1.35, 95% CI [1.04, 1.76]). Similar results were obtained in the complete record analyses as those who communicated with strangers online had greater odds of reporting depressive symptoms at follow-up in the fully adjusted models (OR=1.58, 95% CI [1.17, 2.13]).

Those who communicated online with strangers had greater odds of reporting social anxiety symptoms at follow-up after adjusting for gender, ethnicity, SES, and school in the imputed analyses (OR=1.35, 95% CI [1.06, 1.71]). However this association was attenuated after adjusting for baseline social anxiety symptoms. In the complete record analyses this association was sustained across all three models, including the model additionally adjusted for baseline social anxiety symptoms (OR=1.39, 95% CI [1.06, 1.82]).

Finally, in the imputed analyses, there was a greater risk of reporting below average well-being among those who communicated with strangers online compared to those who did not after adjusting for gender, ethnicity, SES, and school (RRR=1.42, 95% CI [1.04, 1.93]). This association was attenuated, however, after additionally adjusting for baseline well-being. In the complete record results, though the estimated coefficients were similar, this association did not reach statistical significance.

The results from the imputed analyses and the complete record analyses are very similar. As outlined in the methods chapter, the similarity between imputed and complete record analyses was expected as missing data was primarily due to session time rather than individual decisions to omit responses to particular survey items. Imputed analyses have greater power to detect effects and the bias resulting from missing data has been minimised via multiple imputation methods. Notably, complete record analyses had reduced power given smaller sample size compared to the imputed data. For instance, it was not possible to adjust complete record analyses for the 25 category school variable.

4.6 Summary

The purpose of this main results chapter was to illustrate the statistical analyses which have been carried out to address the primary research question of this study. This question asked: "how is the mental health of adolescents impacted by the characteristics of their social media use?" and the results presented here examined both cross-sectional and longitudinal associations between SNS use, IM use, cyberbullying involvement, online network size, and communication with strangers and adolescent mental health. As illustrated above, cross-sectional and longitudinal associations were observed. Most notably, these results indicated the following:

i) Those who used IM several times a day at baseline had a greater risk of reporting below average well-being than average well-being at follow-up compared to their peers who used IM every day or almost every day after adjusting for gender, ethnicity, SES, school, and baseline well-being.

ii) Those who reported being involved in cyberbullying at baseline either as cybervictims or cyberbully-victims had increased odds of reporting depressive symptoms and social anxiety symptoms at follow-up compared to their uninvolved peers after adjusting for gender, ethnicity, SES, school, and baseline mental health. Cybervictims and cyberbully-victims also had a greater risk of reporting below average well-being than average well-being compared to their peers who were uninvolved in cyberbullying after adjusting for gender, ethnicity, SES, and school but this association was attenuated after additionally adjusting for baseline mental well-being.

iii) Those who reported communicating online with strangers at baseline had increased odds of reporting depressive symptoms and social anxiety

symptoms at follow-up and an increased risk of reporting and below-average well-being at follow-up compared to those who did not communicate with strangers online after adjusting for gender, ethnicity, SES, and school. After adjusting for baseline mental health, only the association between communication online with strangers at baseline and depressive symptoms at follow-up was sustained, associations with social anxiety symptoms and mental well-being were attenuated.

Baseline cross-sectional analyses were carried out to enable comparison with previous studies in the literature given that longitudinal research on this topic is still in its infancy. Sensitivity analyses were carried out to additionally adjust the cyberbullying models for a single item from a negative life events questionnaire on whether the adolescent was "ever bullied" in their lifetime. This adjustment aimed to address whether the associations observed were independent of involvement in traditional bullying though this single item measure was severely limited; it only addressed victimisation and not perpetration, it looked at victimisation across the lifespan rather than in the previous year which was the timeframe used in the cyberbullying measure, it did not specifically address traditional victimisation and adolescents may have been referring to instances of bullying which occurred online in their response. Bearing the limitations in mind, the associations between cyberbullying involvement at baseline and adolescent mental health at follow-up were mostly sustained and suggested associations between cyberbullying involvement and mental health outcomes are independent of traditional bullying victimisation. Finally, while the analyses presented were carried out on the multiple imputed datasets, for comparison purposes, the complete record analyses were included in the appendices. The results of the complete record analyses are similar to the results based on the imputed.

The following chapter, Chapter Five, aims to address the secondary research questions outlined for this PhD: "how might the pathways from characteristics of social media use to adolescent mental health differ for males and females?" and "what role might peers and parents play in buffering or exacerbating the impact of the characteristics of adolescents' social media use on their mental health?"

CHAPTER FIVE

SECONDARY RESULTS – EXPLORING THE ROLE OF GENDER, PEER, AND FAMILY FACTORS

5 CHAPTER FIVE: SECONDARY RESULTS

This chapter details the results related to the secondary research questions: "how might the pathways from characteristics of social media use to adolescent mental health differ for males and females?" and "what role might peers and parents play in buffering or exacerbating the impact of the characteristics of adolescents' social media use on their mental health?" To address these research questions, the aim of this chapter was to examine the moderating role of gender, perceived peer support, and family factors (including perceived family support and parental monitoring) in the associations between characteristics of social media use and adolescent mental health. This chapter is divided into five sections:

Section 5.1 includes details relating to the analytic approach taken to address these secondary research questions. Section 5.2 describes analyses relating to gender differences in associations between the characteristics of social media use and adolescent mental health. Section 5.3 describes analyses relating to differences in associations between the characteristics of social media use and adolescent mental health based on perceptions of social support from peers. Section 5.4 describes analyses relating to differences in associations between the characteristics of social media use and adolescent mental health based on perceptions of both social support from family and parental monitoring. Finally, the findings are summarised in Section 5.5.

5.1 Analytic approach used to address the secondary research questions

Originally, the aim was to explore the interactions between the characteristics of social media use (e.g. IM use, cyberbullying involvement, communication with strangers) and gender, peer support, and family factors in associations with adolescent mental health. However, due to a number of analytic limitations, this approach had to be revised. This section details these revisions, their limitations in answering the secondary research questions, and the results of these statistical analyses. These exploratory results, though limited, do offer a number of insights which will be discussed further in Chapter Six.

When using multiple imputation techniques, all variables to be included in analytic models need to be included in the imputation. This includes interaction terms.

In order to answer the secondary research questions, categorical interaction terms were needed. When these interaction terms were included in the imputation using REALCOM software the imputation models would not converge. Therefore, the interaction terms had to be removed from the multiple imputation which meant that interactions could not be modelled using the imputed data. There was not enough power to explore interactions in the complete record data and complete record analyses may have been biased due to the patterns of missing data. Therefore, I decided to stratify analyses in the imputed data to explore differences in the associations between social media use and adolescent mental health based on gender, peer support, and family factors without examining interactions.

The stratified analyses are presented below with the caveat that these analyses may only be considered exploratory given that the interactions have not been tested. The stratification procedure was complicated because peer support and the family factors (perceived family support and parental monitoring) contained missing data. As a result, the number of participants in the low, medium, and high social support groups, and in the medium-high/low parental monitoring groups, varied across imputed data sets. However, the sample size did not vary a great deal between imputations and the imputed data is not thought to be biased, so the variations in the numbers of participants in different cells were not considered to be too problematic. Analyses stratified by gender have been adjusted for ethnicity, SES, and school. However, analyses stratified by perceived peer support, perceived family support, and parental monitoring would not converge when school was included as a fixed effect due to small cell sizes. Therefore, these stratified models have only been adjusted for ethnicity and SES and not school.

Finally, prior to conducting these analyses it was agreed that potential moderators would only be investigated in models where the main effects were observed in the adjusted longitudinal analyses: this included the association between instant messaging use and mental well-being; the associations between cyberbullying and depression, social anxiety and well-being; and the associations between communication online with strangers and depression, social anxiety, and well-being. Notably, as IM use was only associated with mental well-being and not with depressive symptoms or social anxiety symptoms and the stratified analyses only focus on the association between IM use and mental well-being. Stratified analyses were carried out for the adjusted models and the models additionally adjusted for baseline mental health and these are presented below with the caveat that these models should be considered exploratory.

5.2 The role of gender

5.2.1 Gender differences in associations between IM use and well-being

The findings of the main analyses suggested that those who used IM several times a day at baseline had greater risk of reporting below-average well-being at follow-up. This section examines the association between IM use at baseline and mental well-being at follow-up separately for males and females and considers whether the evidence suggests gender differences in this association (Table 53).

5.2.1.1 Males

The results did not suggest evidence for an association between using IM several times a day compared to every day or almost daily among males in the models adjusted for ethnicity, SES, and school, or in the model additionally adjusted for baseline well-being.

5.2.1.2 Females

Similar to males, the results did not suggest evidence for an association between using IM several times a day compared to every day or almost daily among females in the models adjusted for ethnicity, SES, and school, or in the model additionally adjusted for baseline well-being.

5.2.1.3 Gender differences

In terms of associations between IM use and adolescent well-being, the coefficients for males and females are similar and the confidence intervals for males and females overlap considerably which does not suggest any gender differences in the association between IM use and adolescent mental health. The lack of evidence for gender differences may be attributable to the reduction in statistical power to detect effects in the stratified analyses.

Table 53: Longitudinal association between IM use and well-being: Stratified by gender

Instant Messaging	Male (n=1370)		Female (n=1110)	
	Model 1	Model 2	Model 1	Model 2
	RRR [95% CI]	RRR [95% CI]	RRR [95% CI]	RRR [95% CI]
IM several times a day	1.40 [0.80,2.46]	1.32 [0.73,2.38]	1.46 [0.94,2.25]	1.50 [0.94,2.41]
IM every day or almost every day	†	†	†	†
IM once or twice a week or less	1.25 [0.65,2.43]	1.04 [0.52,2.10]	1.04 [0.55,1.97]	1.11 [0.55,2.24]
IM never	1.59 [0.79,3.22]	1.47 [0.70,3.09]	0.94 [0.44,1.99]	0.90 [0.40,2.02]

Reference outcome category: Average well-being
***p<0.05; **p<0.01; ***p<0.001; ~borderline significance (p<0.06)**
Model 1: Adjusted for ethnicity, SES, and School
Model 2: Additionally adjusted for baseline well-being

5.2.2 Gender differences in associations between cyberbullying involvement and adolescent mental health

The findings of the main analyses suggested that baseline cybervictims and cyberbully-victims had greater odds of reporting depressive symptoms and social anxiety symptoms and greater risk of reporting below average mental well-being than their uninvolved peers at follow-up. This section examines the association between cyberbullying involvement at baseline and depressive symptoms, social anxiety symptoms, and mental well-being at follow-up separately for males and females and considers whether the evidence suggests gender differences in these associations (Table 54).

5.2.2.1 Males

Male cybervictims (OR=1.76, 95% CI [1.09, 2.85]) and cyberbully-victims (OR=2.02, 95% CI [1.35, 3.01]) had increased odds of reporting depressive symptoms at follow-up than their uninvolved peers after adjusting for ethnicity, SES, and school. This association was attenuated after additionally adjusting for baseline depressive symptoms for cybervictims (OR=1.45, 95% CI [0.87, 2.42]) and cyberbully-victims (OR=1.52, 95% CI [0.99, 2.35]).

Male cybervictims had increased odds of reporting social anxiety at follow-up after adjustment for ethnicity, SES, and school (OR=1.65, 95% CI [1.08, 2.51]) though

this association was attenuated after adjusting for baseline social anxiety (OR=1.54, 95% CI [0.99, 2.39]).

The stratified analyses did not provide evidence for a longitudinal association between cyberbullying involvement and below average mental well-being in the adjusted model or the model additionally adjusted for baseline well-being among males.

5.2.2.2 Females

Female cybervictims (OR=2.07, 95% CI [1.32, 3.24]) and cyberbully-victims (OR=2.89, 95% CI [1.93, 4.33]) had greater odds of reporting depressive symptoms at follow-up compared to their uninvolved peers in the adjusted models though this association was attenuated after adjusting for baseline depressive symptoms among cybervictims (OR=1.41, 95% CI [0.86, 2.33]) and cyberbully-victims (OR=1.56, 95% CI [0.99, 2.45]).

Female cybervictims (OR=1.76, 95% CI [1.15, 2.73]) and cyberbully-victims (OR=2.06, 95% CI [1.41, 3.02]) had greater odds of reporting social anxiety at follow-up compared to their uninvolved peers. This association was only sustained among cyberbully-victims after additionally adjusting for baseline mental health (OR=1.87, 95% CI [1.24, 2.83]) and was attenuated among cybervictims.

Female cybervictims (RRR=1.80, 95% CI [1.08, 3.01]) and cyberbully-victims (RRR=2.21, 95% CI [1.35, 3.62]) had greater risk of reporting below average well-being at follow-up in the adjusted models though these associations were attenuated after adjusting for baseline well-being among cybervictims (RRR=1.40, 95% CI [0.81, 2.43]) and cyberbully-victims (RRR=1.67, 95% CI [0.98, 2.83]).

5.2.2.3 Gender differences

The estimated coefficients were higher and showed more consistent association with mental health outcomes among females compared to males in the adjusted analyses. This suggests that associations between baseline involvement in cyberbullying as a cybervictim or cyberbully-victim and poorer mental health outcomes at follow-up may be stronger for females. However, the confidence intervals overlap considerably between the male and female estimates; after additionally adjusting for baseline mental health the coefficients are very similar for males and females and the confidence intervals largely overlap. This is with the exception of the association between involvement as a cyberbully-victim and social anxiety. Female cyberbully-victims had greater odds of reporting social anxiety at follow-up than females uninvolved in

cyberbullying but the data did not suggest evidence for an association between cyberbully-victims and social anxiety among males. There is also less overlap between confidence intervals between the male and female estimates which suggests possible gender differences in the associations between baseline cyberbullying involvement and social anxiety at follow-up, particularly for cyberbully-victims.

Table 54: Longitudinal associations between cyberbullying involvement and mental health: Stratified by gender

	Male (n=1370)		**Female (n=1110)**	
	Model 1	**Model 2**	**Model 1**	**Model 2**
Depression	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**
Not involved in cyberbullying	†	†	†	†
Cybervictim	1.76* [1.09, 2.85]	1.45 [0.87, 2.42]	2.07** [1.32, 3.24]	1.41 [0.86, 2.33]
Cyberbully	0.95 [0.46, 1.94]	0.89 [0.42, 1.88]	1.53 [0.88, 2.64]	1.40 [0.77, 2.52]
Cyberbully-victim	2.02** [1.35, 3.01]	1.52~ [0.99, 2.35]	2.89*** [1.93, 4.33]	1.56~ [0.99, 2.45]
Social Anxiety	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**
Not involved in cyberbullying	†	†	†	†
Cybervictim	1.65* [1.08, 2.51]	1.54~ [0.99, 2.39]	1.76* [1.15, 2.73]	1.46 [0.92, 2.32]
Cyberbully	0.70 [0.37, 1.34]	0.76 [0.39, 1.48]	0.85 [0.46, 1.56]	0.89 [0.47, 1.67]
Cyberbully-victim	1.31 [0.92, 1.87]	1.14 [0.78, 1.67]	2.06*** [1.41, 3.02]	1.87** [1.24, 2.83]
Below Average Well-being	**RRR [95% CI]**	**RRR [95% CI]**	**RRR [95% CI]**	**RRR [95% CI]**
Not involved in cyberbullying	†	†	†	†
Cybervictim	1.23 [0.67, 2.28]	1.17 [0.61, 2.23]	1.80* [1.08, 3.01]	1.40 [0.81, 2.43]
Cyberbully	0.76 [0.32, 1.82]	0.77 [0.30, 1.93]	1.45 [0.70, 3.00]	1.40 [0.66, 2.96]
Cyberbully-victim	1.31 [0.80, 2.15]	1.14 [0.67, 1.93]	2.21** [1.35, 3.62]	1.67~ [0.98, 2.83]

Reference outcome categories: Not depressed, not socially anxious, and average mental well-being
***p<0.05; **p<0.01; ***p<0.001; ~borderline significance (p<0.06)**
Model 1: Adjusted for ethnicity, SES, and School
Model 2: Additionally adjusted for baseline mental health

5.2.3 Gender differences in associations between communication with strangers and adolescent mental health

The findings of the main analyses suggested that those who reported communication with strangers at had greater odds of reporting depressive symptoms and social anxiety symptoms at follow-up and greater risk of reporting below average mental well-being at follow-up than their peers who did not communicate with strangers. This section examines the association between baseline communication with strangers and depressive symptoms, social anxiety symptoms, and mental well-being at follow-up separately for males and females and considers the evidence to suggest gender differences in this association. These results are illustrated in Table 55.

5.2.3.1 Males

Males who communicated with strangers at baseline had greater odds of reporting depressive symptoms at follow-up than their peers who did not communicate with strangers in the model adjusted for ethnicity, SES, and school (OR=1.66; 95% CI [1.16, 2.38]). This association attenuated after additionally adjusting for baseline depressive symptoms (OR=1.46, 95% CI [0.99, 2.17]).

The results did not provide evidence for an association between communication with strangers online at baseline and social anxiety symptoms at follow-up among males in the stratified analyses.

In addition, the results did not provide evidence for an association between communication with strangers online at baseline and below average well-being at follow-up among males in the stratified analyses.

5.2.3.2 Females

Females who communicated online with strangers at baseline had greater odds of reporting depressive symptoms at follow-up in the adjusted model (OR=1.54; 95% CI [1.10, 2.18]) though the association was attenuated after additionally adjusting for baseline depressive symptoms (OR=1.24, 95% CI [0.85, 1.80]).

Females who communicated with strangers online had 49% greater odds of reporting social anxiety symptoms at follow-up (95% CI [1.07, 2.08]) in the adjusted model, though the association attenuated after adjusting for baseline social anxiety (OR=1.38, 95%CI [0.94, 2.03]).

In addition, for females, communication with strangers at baseline was associated with increased risk of reporting below average well-being at follow-up in the

adjusted model (RRR=1.55; 95% CI [1.02, 2.35]). This effect was also attenuated after adjusting for baseline well-being (RRR=1.34; 95% CI [0.86, 2.09]).

5.2.3.3 Gender differences

Gender differences in these analyses were minimal. All associations were attenuated after additionally adjusting for baseline mental health. Although there was some evidence for associations between communication with strangers online and mental health among females but not males in the adjusted models, the confidence intervals overlap for males and females which does not suggest that there are gender differences in associations between communication with strangers and mental health.

Table 55: Longitudinal associations between communication with strangers and mental health: Stratified by gender

Communication with strangers	**Male (n=1370)**		**Female (n=1110)**	
	Model 1	**Model 2**	**Model 1**	**Model 2**
Depression	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**
Does not communicate with strangers	†	†	†	†
Communicates with strangers	1.66** [1.16, 2.38]	1.46~ [0.99, 2.17]	1.54* [1.10, 2.18]	1.24 [0.85, 1.80]
Social Anxiety	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**
Does not communicate with strangers	†	†	†	†
Communicates with strangers	1.20 [0.87, 1.66]	1.09 [0.77, 1.53]	1.49* [1.07, 2.08]	1.38 [0.94, 2.03]
Below Average Well-being	**RRR [95% CI]**	**RRR [95% CI]**	**RRR [95% CI]**	**RRR [95% CI]**
Does not communicate with strangers	†	†	†	†
Communicates with strangers	1.29 [0.81, 2.06]	1.23 [0.75, 2.02]	1.55* [1.02, 2.35]	1.34 [0.86, 2.09]

Reference outcome categories: Not depressed, not socially anxious, and average well-being
***p<0.05; **p<0.01; ***p<0.001; ~borderline significance (p<0.06)**
Model 1: Adjusted for ethnicity, SES, and School
Model 2: Additionally adjusted for baseline mental health

5.3 The role of peer support

5.3.1 Differences in associations between IM use and mental well-being based on perceived peer support

The findings of the main analyses suggested that those who used IM several times a day at baseline had greater risk of reporting below-average well-being at follow-up. This section examines the association between IM use at baseline and below average mental well-being at follow-up separately for those with low, medium, and high levels of peer support and considers the evidence to suggest peer support differences in this association (Table 56). Note that in the below tables the sample sizes vary within each category of perceived social support. This is because analyses have been based on the imputed data. As mentioned above, this is due to missing data on the perceived peer support variable; the n varies across the 50 imputed datasets.

5.3.1.1 Low perceived peer support

Among those with low perceived peer support, there some evidence for an association between using IM several times a day at baseline and reporting below average well-being at follow-up (RRR=1.70, 95% CI [1.00, 2.90]) after adjusting for ethnicity and SES. In addition, risk of reporting below average well-being at follow-up was 2.08 times greater among those who never used IM compared to their peers who used IM every day or almost every day (95% CI [1.01, 4.29]). After additionally adjusting for baseline well-being these associations were attenuated.

5.3.1.2 Medium perceived peer support

The stratified analyses did not suggest evidence for an association between IM use at baseline and below average well-being at follow-up for those with medium levels of perceived peer support.

5.3.1.3 High perceived peer support

The stratified analyses did not suggest evidence for an association between IM use at baseline and below average well-being at follow-up for those with high levels of perceived peer support.

5.3.1.4 Peer support differences

These stratified analyses do not suggest that there are differences in the association between baseline IM use and below average well-being at follow-up depending on adolescents' perceptions of social support from their peers.

Table 56: Longitudinal association between IM use and below average well-being: Stratified by perceived peer support

Instant Messaging	Low (n= 915-973)		Medium (n=712-774)		High (n=777-815)	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Below Average Well-being	RRR [95% CI]	RRR [95% CI]	RRR [95% CI]	RRR [95% CI]	RRR [95% CI]	RRR [95% CI]
IM several times a day	1.70~ [1.00,2.90]	1.65 [0.93,2.94]	1.23 [0.66,2.30]	1.21 [0.62,2.36]	1.65 [0.87,3.16]	1.58 [0.81,3.08]
IM every day or almost every day	†	†	†	†	†	†
IM once or twice a week or less	1.31 [0.70,2.48]	1.20 [0.61,2.37]	0.92 [0.39,2.15]	1.05 [0.42,2.61]	0.90 [0.34,2.40]	0.88 [0.32,2.42]
IM never	2.08* [1.01,4.29]	2.02 [0.92,4.45]	0.74 [0.27,2.09]	0.80 [0.27,2.40]	0.68 [0.21,2.22]	0.59 [0.17,2.04]

Reference outcome category: Average well-being
***p<0.05; **p<0.01; ***p<0.001; ~borderline significance (p<0.06)**
Model 1: Adjusted for gender, ethnicity, and SES
Model 2: Additionally adjusted for baseline mental health
Varying n in tables due to differences in n across the 50 imputed datasets

5.3.2 Differences in associations between cyberbullying involvement and mental health based on perceived peer support

The findings of the main analyses suggested that baseline cybervictims and cyberbully-victims had greater odds of reporting depressive symptoms and social anxiety symptoms and greater risk of reporting below average mental well-being than their uninvolved peers at follow-up. This section examines the associations between cyberbullying involvement at baseline and depressive symptoms, social anxiety symptoms, and mental well-being at follow-up separately for those with low, medium, or high levels of perceived peer support and considers the evidence to suggest peer support differences in this association. These results are illustrated in Table 57.

5.3.2.1 Low perceived peer support

Among those with low perceived peer support, cybervictims (OR=1.73; 95% CI [1.01, 2.95]) and cyberbully-victims (OR=2.27; 95% CI [1.51, 3.40]) had greater odds of reporting depressive symptoms at follow-up compared to their uninvolved peers in the adjusted model. This association was attenuated after additionally adjusting for baseline depressive symptoms.

Among those with low levels of perceived peer support, cyberbullying was not associated with symptoms of social anxiety.

Cyberbully-victims (RRR=1.84, 95% CI [1.15, 2.96]) had greater risk of reporting below average well-being at follow-up compared to their uninvolved peers but this association was attenuated after additionally adjusting for baseline well-being. Among those with low perceived peer support in the stratified analyses there was no other evidence for an association between cyberbullying involvement at baseline and mental health at follow-up.

5.3.2.2 Medium perceived peer support

Among those with medium perceived peer support, cybervictims (OR=1.87; 95% CI [1.05, 3.31]) and cyberbully-victims (OR=1.84; 95% CI [1.08, 3.14]) had greater odds of reporting depressive symptoms at follow-up compared to their uninvolved peers in the adjusted model. After additionally adjusting for baseline depressive symptoms these associations were attenuated.

Cybervictims also had greater odds of reporting symptoms of social anxiety at follow-up (OR=1.79; 95% CI [1.04, 3.10]) compared to their uninvolved peers but this association was also attenuated after additionally adjusting for baseline symptoms of social anxiety.

Among those with medium perceived peer support in the stratified analyses there was no evidence for an association between cyberbullying involvement at baseline and mental well-being at follow-up.

5.3.2.3 High perceived peer support

Among those with high levels of perceived peer support, cybervictims (OR=2.41; 95% CI [1.40, 4.16]) and cyberbully-victims (OR=3.32; 95% CI [1.87, 5.91]) had greater odds of reporting depressive symptoms at follow-up compared to uninvolved peers in the adjusted model. After additionally adjusting for baseline depressive symptoms these associations were attenuated.

Cybervictims (OR=2.26; 95% CI [1.29, 3.95]) and cyberbully-victims (OR=1.86, 95% CI [1.08, 3.19]) also had greater odds of reporting symptoms of social anxiety at follow-up than their uninvolved peers but these associations were also attenuated after additionally adjusting for baseline symptoms of social anxiety.

Among those with high perceived peer support, the data did not provide evidence for an association between cyberbullying involvement and mental well-being.

5.3.2.4 Peer support differences

Taking these results together, there is some evidence to suggest that the association between involvement in cyberbullying as a cyberbully-victim at baseline is more strongly associated with depressive symptoms at follow-up for those with high levels of perceived peer support as the coefficient estimate is higher among those with high levels of perceived peer support than among those with low or medium support. The association is also sustained after adjustment for baseline depressive symptoms among those with high perceived peer support. However, the estimated coefficient for the cyberbully-victim group does fall within the upper limit of the confidence intervals for the other two groups so it is possible that there may be no differences in the association between cyberbullying involvement and depressive symptoms according to adolescents' levels of perceived social support from peers.

There is also some evidence to suggest that the association between involvement in cyberbullying as a cybervictim and social anxiety at follow-up may be strongest among those with high peer support as the coefficient is higher for this group. The association is sustained after adjusting for baseline social anxiety symptoms for those with high levels of peer support. Again, however, the estimated coefficient for the cybervictim group does fall within the upper limit of the confidence intervals for the other two groups so it is possible that there may be no differences in the association between cyberbullying involvement and social anxiety symptoms according to adolescents' levels of perceived social support from peers.

Table 57: Longitudinal associations between cyberbullying involvement and mental health: Stratified by perceived peer support

	Low (n= 915-973)		Medium (n=712-774)		High (n=777-815)	
	Model 1	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**
Depression	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**
Not involved	†	†	†	†	†	†
Cybervictim	1.73* [1.01,2.95]	1.36 [0.76,2.43]	1.87* [1.05,3.31]	1.37 [0.73,2.57]	2.41** [1.40,4.16]	1.68 [0.82,3.09]
Cyberbully	1.23 [0.61,2.47]	1.18 [0.57,2.47]	1.20 [0.58,2.52]	1.03 [0.48,2.22]	1.33 [0.61,2.90]	1.25 [0.54,2.90]
Cyberbully-victim	2.27*** [1.51,3.40]	1.44 [0.91,2.28]	1.84* [1.08,3.14]	1.27 [0.70,2.29]	3.32*** [1.87,5.91]	2.16* [1.13,4.13]
Social Anxiety	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**
Not involved	†	†	†	†	†	†
Cybervictim	1.28 [0.79,2.05]	1.13 [0.68,1.88]	1.79* [1.04,3.10]	1.56 [0.88,2.76]	2.26** [1.29,3.95]	2.00* [1.11,3.58]
Cyberbully	0.73 [0.35,1.50]	0.84 [0.40,1.76]	0.91 [0.45,1.84]	0.98 [0.47,2.04]	0.75 [0.34,1.61]	0.71 [0.33,1.56]
Cyberbully-victim	1.39 [0.94,2.06]	1.26 [0.84,1.90]	1.56 [0.96,2.54]	1.42 [0.85,2.38]	1.86* [1.08,3.19]	1.56 [0.88,2.77]
Below Average Well-being	**RRR [95% CI]**	**RRR [95% CI]**	**RRR [95% CI]**	**RRR [95% CI]**	**RRR [95% CI]**	**RRR [95% CI]**
Not involved	†	†	†	†	†	†
Cybervictim	1.43 [0.78,2.61]	1.16 [0.60,2.22]	1.49 [0.71,3.11]	1.18 [0.54,2.59]	1.74 [0.88,3.44]	1.60 [0.77,3.34]
Cyberbully	0.83 [0.29,2.36]	0.88 [0.29,2.61]	1.05 [0.41,2.70]	1.01 [0.37,2.74]	1.84 [0.70,4.82]	1.70 [0.63,4.59]
Cyberbully-victim	1.84* [1.15,2.96]	1.47 [0.88,2.46]	1.56 [0.81,2.99]	1.33 [0.66,2.67]	1.40 [0.63,3.10]	1.26 [0.54,2.91]

Reference outcome categories: Not depressed, not socially anxious, and average well-being

***p<0.05; **p<0.01; ***p<0.001; ~borderline significance (p<0.06)**

Model 1: Adjusted for gender, ethnicity, and SES

Model 2: Additionally adjusted for baseline mental health

Varying n in tables due to differences in n across the 50 imputed datasets

5.3.3 Differences in associations between communication with strangers and mental health based on perceived peer support

The findings of the main analyses suggested that communication with strangers at baseline was associated with depressive symptoms, social anxiety symptoms and below average mental well-being at follow-up. This section examines the association between baseline communication with strangers and depressive symptoms, social anxiety symptoms, and mental well-being at follow-up separately for those with low, medium, and high levels of perceived peer support and considers whether the evidence suggests peer support differences in this association. These results are illustrated in Table 58.

5.3.3.1 Low peer support

Among those with low peer support, there was some evidence for an association between communication with strangers online at baseline and depressive symptoms at follow-up (OR=1.44; 95% CI [0.99, 2.11]) though this association was attenuated after additionally adjusting for baseline depressive symptoms.

Online communication with strangers was not associated with social anxiety or with below average well-being among those with low levels of perceived peer support.

5.3.3.2 Medium peer support

Among those with medium peer support, those who communicated with strangers at baseline had greater odds of reporting depressive symptoms at follow-up compared with those who did not communicate with strangers in the adjusted model (OR=2.03; 95% CI [1.28, 3.23]) and the model additionally adjusted for baseline depressive symptoms (OR=1.75, 95% CI [1.06, 2.89).

Communication with strangers online was not associated with social anxiety or well-being among those with medium levels of perceived peer support.

5.3.3.3 High peer support

Among those with high peer support those who communicated with strangers had greater odds of reporting social anxiety symptoms at follow-up (OR= 1.54; 95% CI [1.01, 2.36]) though this association was attenuated after additionally adjusting for baseline social anxiety symptoms.

Communication with strangers online was not associated with depressive symptoms or well-being among those with high levels perceived peer support.

5.3.3.4 Peer support differences

The estimated coefficient is higher for the medium peer support group than it is for the high or low support groups. However, the estimated coefficient for the medium peer support group does fall within the confidence intervals of the high and low peer support group. As such, it is unlikely that the association between communication online with strangers and depressive symptoms differs according to perceived level of social support from peers.

Table 58: Longitudinal associations between communication with strangers and mental health: Stratified by perceived peer support

	Low (n= 915-973)		Medium (n=712-774)		High (n=777-815)	
	Model 1	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**
Depression	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**
Does not communicate with strangers	†	†	†	†	†	†
Communicates with strangers	1.44~ [0.99, 2.11]	1.20 [0.78, 1.84]	2.03** [1.28, 3.23]	1.75* [1.06, 2.89]	1.50 [0.92, 2.43]	1.26 [0.73, 2.16]
Social Anxiety	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**
Does not communicate with strangers	†	†	†	†	†	†
Communicates with strangers	1.13 [0.79, 1.63]	0.98 [0.67, 1.45]	1.35 [0.87, 2.10]	1.26 [0.80, 2.01]	1.54* [1.01, 2.36]	1.44 [0.92, 2.25]
Below Average Well-being	**RRR [95% CI]**	**RRR [95% CI]**	**RRR [95% CI]**	**RRR [95% CI]**	**RRR [95% CI]**	**RRR [95% CI]**
Does not communicate with strangers	†	†	†	†	†	†
Communicates with strangers	1.34 [0.86, 2.10]	1.21 [0.75, 1.96]	1.50 [0.84, 2.67]	1.25 [0.67, 2.34]	1.55 [0.82, 2.92]	1.51 [0.78, 2.93]

Reference outcome categories: Not depressed, not socially anxious, and average well-being

***p<0.05; **p<0.01; ***p<0.001; ~borderline significance (p<0.06)**

Model 1: Adjusted for gender, ethnicity, and SES

Model 2: Additionally adjusted for baseline mental health

Varying n in tables due to differences in n across the 50 imputed datasets

5.4 The role of family factors

The family factors explored included participants' perceptions of their social support from their families and also their perceptions of the extent to which they are monitored by their parents. Analyses stratified by perceptions of family support and by parental monitoring have been carried out on: associations between IM use and mental well-being; associations between cyberbullying involvement and depressive symptoms, social anxiety symptoms and mental well-being; and on associations between communication with strangers and depressive symptoms, social anxiety symptoms, and mental well-being.

5.4.1 Perceived family support

5.4.1.1 Association between IM use and well-being

The findings of the main analyses suggested that those who used IM several times a day at baseline had greater risk of reporting below-average well-being at follow-up compared to their peers who used IM every day or almost every day. This section examines the association between IM use at baseline and below average mental well-being at follow-up separately for those with low, medium, and high levels of perceived social support from family and considers the evidence to suggest family support differences in this association. These results are illustrated in Table 59.

5.4.1.1.1 Low family support

Among those with low family support, those who used IM several times a day had greater risk of reporting below average well-being at follow-up than their peers who used IM every day or almost every day in the adjusted model (RRR=1.66; 95% CI [1.02, 2.68]) and the model additionally adjusted for baseline mental well-being (RRR=1.71; 95% CI [1.02, 2.86]).

5.4.1.1.2 Medium family support

Among those with medium family support, the results did not suggest evidence for an association between IM use and well-being in the adjusted stratified analyses or analyses additionally adjusted for baseline mental well-being.

5.4.1.1.3 High family support

Among those with high family support, the data did not suggest evidence for an association between IM use and well-being in the adjusted stratified analyses or analyses additionally adjusted for baseline mental well-being.

5.4.1.1.4 Family support differences

While the findings in the low family support group suggest that the association between IM use and well-being may be strongest in this group, the confidence intervals estimated across all three family social support strata are very similar and as such there is little evidence to suggest that the association between IM use and well-being differs based on adolescents' perceptions of social support from their family.

Table 59: Longitudinal association between IM use and well-being: Stratified by perceived family support

	Low (n= 836-884)		Medium (n=848-889)		High (n=736-773)	
	Model 1	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**
Below Average Well-being	**RRR [95% CI]**	**RRR [95% CI]**	**RRR [95% CI]**	**RRR [95% CI]**	**RRR [95% CI]**	**RRR [95% CI]**
IM several times a day	1.66* [1.02,2.68]	1.71* [1.02,2.86]	1.26 [0.68,2.34]	1.29 [0.67,2.47]	1.33 [0.57,3.09]	1.20 [0.50,2.88]
IM every day or almost every day	†	†	†	†	†	†
IM once or twice a week or less	1.06 [0.55,2.06]	1.02 [0.51,2.05]	1.02 [0.43,2.45]	1.06 [0.42,2.63]	1.23 [0.46,3.28]	1.07 [0.38,2.98]
IM never	1.82 [0.90,3.72]	1.87 [0.88,3.99]	1.16 [0.49,2.76]	1.19 [0.47,3.04]	0.70 [0.18,2.70]	0.50 [0.12,2.11]

Reference outcome category: Average well-being
***p<0.05; **p<0.01; ***p<0.001; ~borderline significance (p<0.06)**
Model 1: Adjusted for gender, ethnicity, and SES
Model 2: Additionally adjusted for baseline mental well-being
Varying n in tables due to differences in n across the 50 imputed datasets

5.4.1.2 Associations between cyberbullying involvement and mental health

The findings of the main analyses suggested that baseline cybervictims and cyberbully-victims had greater odds of reporting depressive symptoms and social anxiety symptoms and greater risk of reporting below average mental well-being than their uninvolved peers at follow-up. This section examines the association between baseline cyberbullying involvement and depressive symptoms, social anxiety symptoms, and mental well-being at follow-up separately for those with low, medium, and high levels of perceived family support and considers the evidence to suggest family support differences in this association. These results are illustrated in Table 60.

5.4.1.2.1 Low family support

Among those with low perceived social support from family, cybervictims (OR=1.71; 95% CI [0.99, 2.94]) and cyberbully-victims (OR=1.87; 95% CI [1.24, 2.84]) had greater odds of reporting symptoms of depression at follow-up than their peers uninvolved in cyberbullying. However, these associations were attenuated after additionally adjusting for baseline depressive symptoms.

Among those with low levels of perceived support from family, cyberbullying involvement was not associated with social anxiety symptoms.

There was some evidence to suggest cyberbully-victims had greater risk of reporting report below average well-being at follow-up than their uninvolved peers (RRR=1.61, 95% CI [0.99, 2.59]), though, this was attenuated after adjusting for baseline well-being.

5.4.1.2.2 Medium family support

Among those with medium family support, cyberbullying involvement was not associated with depressive symptoms.

Cyberbully-victims had greater odds of reporting social anxiety symptoms at follow-up than their uninvolved peers (OR=1.72, 95% CI [1.06, 2.78]) though this was attenuated after additionally adjusting for baseline mental health.

Cyberbullying involvement was not associated with mental well-being among adolescents with medium levels of perceived social support from family.

5.4.1.2.3 High family support

Among those with high family support, cybervictims (OR=2.39; 95% CI [1.27, 4.49]) and cyberbully-victims (OR=3.68; 95% CI [1.95, 6.95]) had greater odds of reporting depressive symptoms at follow-up than their uninvolved peers. These associations were somewhat attenuated for cybervictims (OR=1.96, 95% CI [0.99, 3.90]) and for cyberbully-victims (OR=2.85, 95% CI [1.43, 5.70]) after additionally adjusting for baseline depressive symptoms.

In addition, those adolescents with high levels of family support who reported involvement as cybervictims at baseline had greater odds of reporting symptoms of social anxiety at follow-up in the adjusted model (OR=2.67; 95% CI [1.50, 4.78]) and this association was sustained after additionally adjusting for baseline social anxiety symptoms (OR=2.36; 95% CI [1.27, 4.38]).

The data did not suggest an association between baseline cyberbullying involvement and mental well-being at follow-up among those with high levels of perceived family support.

5.4.1.2.4 Family support differences

There was some evidence to suggest that the associations between cyberbullying involvement at baseline and depressive symptoms at follow-up were strongest among those with high levels of perceived support from family, particularly for those involved as cyberbully-victims. The estimated coefficient for cyberbully-victims with high perceived family support was higher than that for cyberbully-victims with low or medium family support, and the association was sustained even after adjusting for baseline depressive symptoms among those with high family support only. There was also little overlap between the confidence intervals comparing the fully adjusted models for those with high family support to those with low or medium levels of family support and the estimated coefficient for cyberbully-victims with high levels of perceived family support did not fall within the confidence intervals observed for those with low or medium levels of family support. There was also some evidence to suggest that there was a stronger association between reporting being a cybervictim and social anxiety symptoms at follow-up among those with high levels of perceived family support compared to those with medium or low levels of family support.

Table 60: Longitudinal associations between cyberbullying involvement and mental health: Stratified by perceived family support

	Low (n= 836-884)		Medium (n=848-889)		High (n=736-773)	
	Model 1	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**
Depression	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**
Not involved	†	†	†	†	†	†
Cybervictim	1.71~ [0.99,2.94]	1.44 [0.80,2.57]	1.62 [0.94,2.80]	1.02 [0.54,1.92]	2.39** [1.27,4.49]	1.96~ [0.99,3.90]
Cyberbully	1.04 [0.54,1.99]	1.07 [0.54,2.12]	1.02 [0.48,2.18]	0.79 [0.34,1.83]	1.77 [0.78,4.05]	1.80 [0.77,4.18]
Cyberbully-victim	1.87** [1.24,2.84]	1.35 [0.86,2.11]	1.58 [0.91,2.76]	1.00 [0.54,1.87]	3.68*** [1.95,6.95]	2.85** [1.43,5.70]
Social Anxiety	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**
Not involved	†	†	†	†	†	†
Cybervictim	1.27 [0.77,2.08]	1.12 [0.65,1.90]	1.48 [0.89,2.45]	1.36 [0.81,2.28]	2.67** [1.50,4.78]	2.36** [1.27,4.38]
Cyberbully	0.92 [0.48,1.74]	1.11 [0.58,2.16]	0.56 [0.25,1.25]	0.61 [0.27,1.37]	0.73 [0.29,1.79]	0.66 [0.26,1.70]
Cyberbully-victim	1.25 [0.85,1.81]	1.21 [0.81,1.80]	1.72* [1.06,2.78]	1.55 [0.95,2.56]	1.40 [0.74,2.64]	1.16 [0.59,2.29]
Below Average Well-being	**RRR [95% CI]**	**RRR [95% CI]**	**RRR [95% CI]**	**RRR [95% CI]**	**RRR [95% CI]**	**RRR [95% CI]**
Not involved	†	†	†	†	†	†
Cybervictim	1.43 [0.81,2.53]	1.24 [0.68,2.26]	1.49 [0.76,2.92]	1.27 [0.62,2.57]	0.94 [0.35,2.49]	0.90 [0.33,2.43]
Cyberbully	0.87 [0.38,2.01]	0.92 [0.39,2.16]	0.99 [0.38,2.55]	0.93 [0.34,2.54]	1.31 [0.38,4.49]	1.33 [0.38,4.67]
Cyberbully-victim	1.61~ [0.99,2.59]	1.36 [0.82,2.27]	0.67 [0.27,1.66]	0.62 [0.23,1.64]	1.70 [0.72,4.02]	1.77 [0.72,4.33]

Reference outcome categories: Not depressed, not socially anxious, and average well-being

***p<0.05; **p<0.01; ***p<0.001; ~borderline significance (p<0.06)**

Model 1: Adjusted for gender, ethnicity, and SES

Model 2: Additionally adjusted for baseline mental health

Varying n in tables due to differences in n across the 50 imputed datasets

5.4.1.3 Associations between communication with strangers and mental health

The findings of the main analyses suggested an association between communication with strangers at baseline and depressive symptoms, social anxiety symptoms and below average mental well-being at follow-up. This section examines the association between baseline communication with strangers and depressive symptoms, social anxiety symptoms, and mental well-being at follow-up separately for those with low, medium, and high levels of perceived family support and considers the evidence to suggest family support differences in this association.

As illustrated in Table 61, the data did not suggest evidence for associations between communication with strangers and depressive symptoms, social anxiety symptoms, and mental well-being in the analyses stratified by perceived family support. This suggests that associations between communication with strangers and mental health are unlikely to differ according to adolescents' levels of perceived family support.

Table 61: Longitudinal associations between communication with strangers and mental health: Stratified by perceived family support

	Low (n= 836-884)		Medium (n=848-889)		High (n=736-773)	
	Model 1	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**
Depression	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**
Does not communicate with strangers	†	†	†	†	†	†
Communicates with strangers	1.37 [0.95,1.98]	1.22 [0.83,1.79]	1.47 [0.93,2.30]	1.26 [0.77,2.08]	1.69 [0.98,2.92]	1.49 [0.82,2.70]
Social Anxiety	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**
Does not communicate with strangers	†	†	†	†	†	†
Communicates with strangers	1.06 [0.74,1.52]	0.97 [0.67,1.41]	1.30 [0.86,1.98]	1.22 [0.79,1.88]	1.51 [0.91,2.49]	1.41 [0.83,2.39]
Below Average Well-being	**RRR [95% CI]**	**RRR [95% CI]**	**RRR [95% CI]**	**RRR [95% CI]**	**RRR [95% CI]**	**RRR [95% CI]**
Does not communicate with strangers	†	†	†	†	†	†
Communicates with strangers	1.37 [0.91,2.06]	1.28 [0.83,1.98]	1.01 [0.54,1.87]	0.95 [0.49,1.83]	1.59 [0.75,3.40]	1.65 [0.75,3.64]

Reference outcome categories: Not depressed, not socially anxious, and average well-being

***p<0.05; **p<0.01; ***p<0.001; ~borderline significance (p<0.06)**

Model 1: Adjusted for gender, ethnicity, and SES

Model 2: Additionally adjusted for baseline mental health

Varying n in tables due to differences in n across the 50 imputed datasets

5.4.2 Parental monitoring

This section examines the role of parental monitoring in associations between the characteristics of adolescent social media use at baseline and mental health at follow-up.

5.4.2.1 Association between IM use and well-being

The findings of the main analyses suggested that those who used IM several times a day at baseline had greater risk of reporting below-average well-being at follow-up. In terms of parental monitoring, Table 62 indicates that there is little evidence for an association between IM use at baseline and well-being at follow-up among those with low or those with medium-high levels of parental monitoring. It is unlikely that the association between IM use and below-average well-being observed in this study differs according to adolescents' levels of parental monitoring.

Table 62: Longitudinal association between IM use and well-being: Stratified by parental monitoring

	Parental monitoring: Medium-to-high (n=1815-1871)		**Parental monitoring: Low (n=609-665)**	
	Model 1	**Model 2**	**Model 1**	**Model 2**
	RRR [95%CI]	**RRR [95%CI]**	**RRR [95%CI]**	**RRR [95%CI]**
IM several times a day	1.47 [0.97,2.24]	1.51 [0.97,2.34]	1.63 [0.94,2.84]	1.50 [0.83,2.71]
IM every day or almost every day	†	†	†	†
IM once or twice a week or less	1.10 [0.65,1.86]	1.13 [0.65,1.97]	0.99 [0.44,2.23]	0.78 [0.32,1.89]
IM never	1.16 [0.64,2.10]	1.14 [0.61,2.15]	1.71 [0.68,4.31]	1.43 [0.54,3.82]

Reference outcome category: Average well-being
***p<0.05; **p<0.01; ***p<0.001; ~borderline significance (p<0.06)**
Model 1: Adjusted for gender, ethnicity, and SES
Model 2: Additionally adjusted for baseline mental well-being
Varying n in tables due to differences in n across the 50 imputed datasets

5.4.2.2 Associations between cyberbullying involvement and mental health

The findings of the main analyses suggested that baseline cybervictims and cyberbully-victims had greater odds of reporting depressive symptoms and social anxiety symptoms at follow-up and had greater risk of reporting below average mental well-being than their uninvolved peers at follow-up. This section examines the association between baseline cyberbullying involvement and mental health at follow-up separately for those with medium-high levels of perceived parental monitoring and those with low levels of perceived parental monitoring and considers whether the evidence suggests parental monitoring differences in these associations. These results are illustrated in Table 63.

5.4.2.2.1 Medium-high parental monitoring

Among those with medium-to-high levels of parental monitoring, cybervictims (OR=1.98, 95% CI [1.37, 2.85]) and cyberbully-victims (OR= 1.95, 95% CI [1.36, 2.79]) had greater odds of reporting symptoms of depression at follow-up than their peers uninvolved in cyberbullying. These associations were attenuated after adjusting for baseline depressive symptoms.

Among those with medium-to-high levels of parental monitoring, cybervictims (OR=1.73, 95% CI [1.24, 2.40]) and cyberbully-victims (OR= 1.44, 95% CI [1.03, 2.01]) had greater odds of reporting symptoms of social anxiety at follow-up than their peers uninvolved in cyberbullying. After additionally adjusting for baseline social anxiety symptoms, cybervictims with medium-to-high levels of parental monitoring still had greater odds of reporting social anxiety symptoms at follow-up compared to their uninvolved peers.

Finally, among those with medium-high levels of parental monitoring, cybervictims (RRR=1.63, 95% CI [1.06, 2.50]) and cyberbully-victims (RRR=1.71, 95% CI [1.09, 2.68]) had greater risk of reporting below average well-being at follow-up compared to their uninvolved peers. These associations, however, were attenuated after adjusting for baseline well-being.

5.4.2.2.2 Low parental monitoring

Among those with low levels of parental monitoring, cyberbully-victims had greater odds of reporting symptoms of depression at follow-up than their uninvolved peers (OR=1.74, 95% CI [1.09, 2.77]), though this effect was attenuated after additionally adjusting for baseline depressive symptoms.

There was little evidence for association between reporting being a cybervictim and depressive symptoms at follow-up among those in the low parental monitoring group. Similarly, there was little evidence for an association between cyberbullying involvement and social anxiety symptoms and mental well-being among those with low levels of parental monitoring.

5.4.2.2.3 Parental monitoring differences

These results suggest that those with medium-high levels of parental monitoring reported poorer mental outcomes in relation to cyberbullying involvement compared to their peers with low levels of parental monitoring. However, this must be interpreted with the caveat that there is lower power to detect effects in the low parental monitoring group due to a smaller sub-sample in the low parental monitoring stratum. There is considerable overlap in the confidence intervals for those in the medium-high parental monitoring group compared to those in the low parental monitoring group and as such there is little evidence to suggest parental monitoring differences in associations between cyberbullying involvement at baseline and mental health at follow-up.

Table 63: Longitudinal associations between cyberbullying involvement and mental health: Stratified by parental monitoring

	Parental monitoring: Medium-to-high (n=1815-1871)		Parental monitoring: Low (n=609-665)	
	Model 1	**Model 2**	**Model 1**	**Model 2**
Depression	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**
Not involved in cyberbullying	†	†	†	†
Cybervictim	1.98*** [1.37, 2.85]	1.41 [0.94,2.11]	1.48 [0.83,2.62]	1.27 [0.68,2.37]
Cyberbully	1.14 [0.69,1.91]	1.13 [0.66,1.94]	0.98 [0.51,1.88]	0.92 [0.45,1.88]
Cyberbully-victim	1.95*** [1.36, 2.79]	1.33 [0.88,2.00]	1.74* [1.09,2.77]	1.28 [0.77,2.12]
Social Anxiety	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**
Not involved in cyberbullying	†	†	†	†
Cybervictim	1.73** [1.24,2.40]	1.48* [1.05,2.09]	1.39 [0.79,2.45]	1.33 [0.72,2.48]
Cyberbully	0.76 [0.45,1.28]	0.83 [0.48,1.42]	0.67 [0.34,1.29]	0.73 [0.36,1.48]
Cyberbully-victim	1.44* [1.03,2.01]	1.27 [0.89,1.82]	1.25 [0.79,1.97]	1.18 [0.73,1.92]
Below Average Well-being	**RRR [95% CI]**	**RRR [95% CI]**	**RRR [95% CI]**	**RRR [95% CI]**
Not involved in cyberbullying	†	†	†	†
Cybervictim	1.63* [1.06,2.50]	1.38 [0.87,2.18]	1.01 [0.48,2.11]	0.90 [0.41,1.97]
Cyberbully	0.98 [0.45,2.11]	0.96 [0.43,2.15]	0.85 [0.36,2.01]	0.95 [0.38,2.40]
Cyberbully-victim	1.71* [1.09,2.68]	1.42 [0.88,2.31]	1.00 [0.56,1.78]	0.91 [0.49,1.70]

Reference outcome categories: Not depressed, not socially anxious, and average well-being

***p<0.05; **p<0.01; ***p<0.001; ~borderline significance (p<0.06)**

Model 1: Adjusted for gender, ethnicity, and SES

Model 2: Additionally adjusted for baseline mental health

Varying n in tables due to differences in n across the 50 imputed datasets

5.4.2.3 Associations between communication with strangers and mental health

The findings of the main analyses suggested that those who reported online communication with strangers at baseline had greater odds of reporting depressive symptoms and social anxiety symptoms and increased risk of reporting below average mental well-being at follow-up compared to their peers who did not communicate online with strangers. This section examines the association between baseline communication with strangers and mental health at follow-up separately for those with medium-high levels of perceived parental monitoring and those with low levels of perceived parental monitoring and considers the evidence to suggest parental monitoring differences in this association. These results are illustrated in Table 64.

5.4.2.3.1 Medium-high parental monitoring

Among those with medium-high levels of parental monitoring, those who communicated with strangers online had greater odds of reporting depressive symptoms at follow-up than their peers who did not communicate with strangers both in the adjusted model (OR=1.57, 95% CI [1.18, 2.10]) and the model additionally adjusted for baseline depressive symptoms (OR=1.43, 95% CI [1.04, 1.98]).

The data did not suggest evidence for an association between online communication with strangers at baseline and social anxiety and well-being at follow-up for those with medium-high levels of perceived parental monitoring.

5.4.2.3.2 Low parental monitoring

Among those with low levels of parental monitoring the data did not suggest an association between online communication with strangers at baseline and depressive symptoms, social anxiety symptoms, or well-being at follow-up.

5.4.2.3.3 Parental monitoring differences

There results that communication with strangers may be more strongly associated with depressive symptoms at follow-up among those with medium-high levels of parental monitoring compared to those with low levels of parental monitoring. This must be interpreted with the caveat that there is lower power to detect effects in the low parental monitoring group due to a smaller sub-sample in the low parental monitoring stratum. There is considerable overlap in the confidence intervals for those in the medium-high parental monitoring group compared to those in the low parental monitoring group and as such there is little unequivocal evidence to suggest parental monitoring differences in associations between communication with strangers at baseline and mental health at follow-up.

Table 64: Longitudinal associations between communication with strangers and mental health: Stratified by parental monitoring

	Parental monitoring: Medium-to-high (n=1815-1871)		Parental monitoring: Low (n=609-665)	
	Model 1	**Model 2**	**Model 1**	**Model 2**
Depression	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**
Does not communicate with strangers	†	†	†	†
Communicates with strangers	1.57** [1.18, 2.10]	1.43* [1.04, 1.98]	1.07 [0.72, 1.59]	0.94 [0.61, 1.45]
Social Anxiety	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**
Does not communicate with strangers	†	†	†	†
Communicates with strangers	1.33 [0.98, 1.79]	1.24 [0.90, 1.69]	0.98 [0.66, 1.46]	0.87 [0.57, 1.34]
Below Average Well-being	**RRR [95% CI]**	**RRR [95% CI]**	**RRR [95% CI]**	**RRR [95% CI]**
Does not communicate with strangers	†	†	†	†
Communicates with strangers	1.38 [0.93, 2.05]	1.27 [0.84, 1.93]	1.08 [0.67, 1.76]	1.09 [0.65, 1.83]

Reference outcome categories: Not depressed, not socially anxious, and average well-being

***p<0.05; **p<0.01; ***p<0.001; ~borderline significance (p<0.06)**

Model 1: Adjusted for gender, ethnicity, and SES

Model 2: Additionally adjusted for baseline mental health

Varying n in tables due to differences in n across the 50 imputed datasets

5.5 Summary

The purpose of this chapter was to illustrate the statistical analyses which have been carried out to address the secondary research questions of this study which asked: "how might the associations between characteristics of social media use to adolescent mental health differ for girls and boys?" and "what role might peers and parents play in buffering or exacerbating the impact of the characteristics of adolescents' social media use on their mental health?" The stratified results presented here explored the extent to which the data suggested differences in associations between social media characteristics and mental health based on adolescents' gender, perceived peer social support, perceived family social support, and perceived parental monitoring. Whilst unable to include interaction terms in main analyses the stratified analyses did yield a number of tentative findings. The following is a summary of findings described in this chapter:

i) Role of gender

i. Associations between involvement in cyberbullying as a cyberbully-victim and social anxiety symptoms at one year follow-up may be stronger among females than males.
ii. The results did not suggest gender differences in the association between IM use and below average well-being, or in the association between communication with strangers online and mental health outcomes.

ii) Role of perceived peer support

i. The results did not suggest differences based on adolescents' level of perceived peer support in the association between IM use and below average well-being, the association between cyberbullying involvement and mental health outcomes, or in the association between communication with strangers online and mental health outcomes.

iii) Role of perceived family support

a. Perceived social support from family

i. The association between involvement in cyberbullying as a cyberbully-victim and depressive symptoms at one year follow-up may be strongest among those with high levels of perceived support from family.

ii. The association between involvement in cyberbullying as a cybervictim and social anxiety symptoms at one year follow-up was strongest among those with high levels of perceived support from family.

iii. The results did not suggest differences in the association between IM use and below average well-being, or in the association between communication with strangers online and adolescent mental health outcomes based on adolescents' level of perceived family support.

b. Parental monitoring

i. It is likely that the analyses stratified by parental monitoring were insufficiently powered to detect differences in associations between each of the characteristics of social media use and adolescent depressive symptoms, social anxiety symptoms, and mental well-being.

These findings and their implications are discussed in the discussion in the following chapter, Chapter Six. Throughout Chapter Five the strengths and limitations of this approach to addressing exploratory analyses of moderating effects in the imputed data were discussed. Notably, a number of alternatives were considered. The decision to use the stratified analyses based on the imputed data was selected for two main reasons. First, using the imputed data means that the main analyses and these exploratory analyses are based on the same sample of adolescents and second, there is greater power to detect effects in the imputed data compared to approaches which use complete record data in which sample size is reduced, and likely biased, due to missing data. The following section of Chapter Five provides details on one alternative approach which was employed to enable comparisons with the stratified analyses presented in this chapter. This alternative approach involved testing the interaction effects in the complete record follow-up data. There was less missing data at follow-up than at baseline and as such there is greater power to test for interaction effects in the follow-up cross-sectional data. For reference, the results of these analyses have been reported in Appendix 7. These analyses allowed for the statistical testing of interactions and as such were carried out to test the moderating role of gender, perceived peer support, perceived family support, and parental monitoring in associations between each of the five social media characteristics (SNS use, IM use, cyberbullying involvement, network size, and

communication with strangers online) and the three mental health outcomes (depressive symptoms, social anxiety symptoms, and mental well-being) all measured at follow-up.

5.6 Exploring moderation in the follow-up cross-sectional data

These additional analyses have been carried out to test the moderating role of gender, perceived peer support, perceived family support, and parental monitoring in associations between each of the five social media characteristics (SNS use, IM use, cyberbullying involvement, network size, and communication with strangers online) and the three mental health outcomes (depressive symptoms, social anxiety symptoms, and mental well-being).

Where similar models have been run on both data sets, the findings of the stratified analyses and complete record analyses are compared. Additionally, where a main effect was not observed in the imputed data, complete record analyses were still carried out and the results are discussed. This included an exploration of the moderating role of gender, perceived peer support, perceived family support, and parental monitoring in associations between: SNS use and each of the mental outcomes; IM use and symptoms of depression and social anxiety; and network size and depressive symptoms, social anxiety symptoms, and mental well-being.

5.6.1 Role of gender

Neither the stratified results based on the imputed data nor the analyses which examined the moderating effect of gender in the complete record follow-up cross-sectional data provided evidence for a gender difference in the association between IM use and mental well-being.

Based on the stratified longitudinal analyses of the imputed data there was some evidence to suggest a moderating effect of gender in associations between cyberbullying involvement at baseline and social anxiety symptoms at follow-up with a stronger association between being a cyberbully-victim and social anxiety symptoms suggested for females compared to males. However, the test for interaction based on the follow-up cross-sectional did not provide evidence to support this moderating effect of gender in associations between cyberbullying involvement and social anxiety symptoms. There may be multiple reasons for this – the moderating effect may not exist, the moderating effect may not be observable using cross-sectional data as gender may moderate the association between cyberbullying involvement and future mental health outcomes rather than current mental health, or it is possible that this moderating effect of gender may be isolated to cyberbullying involvement occurring earlier in adolescence around

age 12 or 13 when the baseline measures were taken but may not still exist at ages 13 and 14 when the follow-up data was collected.

A moderating effect of gender in associations between online communication with strangers was not observed in the stratified longitudinal imputed analyses or in the tests for an interaction carried out using the cross-sectional complete record data.

Based on the longitudinal imputed data, there was no evidence for an association between SNS use and adolescent mental health outcomes. Tests for interaction were carried out using the complete record data, however, and there was some evidence to suggest a moderating effect of gender in associations between SNS use and mental well-being. Females who used SNS several times a day had a greater risk of reporting below average well-being than their peers who used SNS every day or almost daily but an association between SNS use and mental well-being was not observed for males. In addition, there was some evidence to suggest a moderating effect of gender in associations between network size and mental well-being. There was an increased risk of reporting above average well-being for males with over 300 friends compared to males with up to 100 friends while an association between online network size and mental well-being was not observed among females.

5.6.2 Role of perceived peer support

The data did not suggest evidence for a moderating role of perceived peer support in associations between IM use and mental well-being either in the stratified longitudinal analyses of imputed data or the tests of interaction effects based on the complete record follow-up data.

The stratified longitudinal analyses of the imputed data did not provide convincing evidence to suggest a moderating effect of perceived social support from peers in associations between cyberbullying involvement and adolescent mental health outcomes. There was some suggestion that poorest mental health outcomes (in relation to depressive symptoms and social anxiety symptoms) were observed for those with high levels of perceived peer support but the confidence intervals overlapped considerably so there was little evidence for an moderating effect. However, analyses based on the complete record follow-up cross-sectional data did suggest that cyberbully-victims with highest levels of perceived peer support had lower risk of reporting above average well-being than their uninvolved peers but the data did not suggest evidence for

an association between cyberbullying involvement and well-being among those with low or medium levels of well-being.

The data did not suggest evidence for a moderating role of perceived peer support in associations between communication with strangers online and mental well-being either in the stratified longitudinal analyses of imputed data or the tests of interaction effects based on the complete record follow-up data.

Though not tested in the stratified longitudinal analyses of imputed data the interaction tests based on the complete record follow-up data suggested evidence for a moderating effect of perceived peer support in associations between SNS use and depressive symptoms with increased odds of reporting depressive symptoms for using SNS several times a day compared to every day or almost daily among those with medium levels of peer support only but not those with low or high peer support.

5.6.3 Perceived family support

The data did not suggest evidence for a moderating role of perceived family support in associations between IM use and mental well-being either in the stratified longitudinal analyses of imputed data or the tests of interaction effects based on the complete record follow-up data. However, analyses based on the complete record follow-up data suggested evidence for a moderating role of family support in the association between IM use and depressive symptoms. The stratified analyses indicated increased odds of reporting depressive symptoms for using IM several times a day compared to every day or almost daily among those with medium levels of family support only but not those with low or high family support.

The stratified longitudinal analyses based on the imputed data provided some evidence towards a moderating effect of perceived family support in associations between cyberbullying involvement and adolescent depressive symptoms and social anxiety symptoms. First, the association between involvement in cyberbullying as a cyberbully-victim and depressive symptoms at one year follow-up was strongest among those with high levels of perceived support from family; and second, the association between involvement in cyberbullying as a cybervictim and social anxiety symptoms at one year follow-up was strongest among those with high levels of perceived social support from family. The stratified analyses carried out on the imputed data did not suggest a moderating role of perceived family support in associations between

cyberbullying involvement and depressive symptoms or social anxiety symptoms. However, tests of the interaction effect on the complete record follow-up data did suggest a moderating role of perceived family support in associations between cyberbullying involvement and mental well-being. Among those with high levels of perceived family support, involvement in cyberbullying as a cyberbully-victim was associated with a reduction in risk of reporting above average well-being compared to uninvolved peers. An association between cyberbullying involvement and above average well-being was not observed for those with low or medium levels of social support from family. While this interaction is with a different mental health outcome variable it does provide some evidence to suggest poorest mental health outcomes for those with high levels of perceived social support from family. While this does not support Hypothesis 7c, it is broadly consistent with what was observed in the stratified analyses of the longitudinal imputed data.

The data did not suggest evidence for a moderating role of perceived family support in associations between communication with strangers online and mental well-being either in the stratified longitudinal analyses of imputed data or the tests of interaction effects based on the complete record follow-up data.

Though not tested in the stratified longitudinal analyses of imputed data the interaction tests based on the complete record follow-up data suggested evidence for a moderating effect of perceived family support in associations between online network size and adolescent well-being with increased risk of reporting above average well-being among those with 101-300 friends online compared to up to 100 friends online for those with medium levels of family support only.

Issues related to power in the parental monitoring stratified analyses have been outlined already in Chapter and as such it is difficult to differences in strata may be due to different power to detect effects in each strata. The stratified analyses which were carried out on the longitudinal data suggested that communication with strangers online was associated with poorer mental health outcomes for those with medium-high levels of parental monitoring. Similar findings were observed when the interaction effect was tested in the complete record follow-up data. First, among those with medium-high levels of parental monitoring, communication with strangers online was associated with an increased risk of reporting depressive symptoms compared to those who did not communicate with strangers, while an association between online communication with

strangers and depressive symptoms was not observed for those who reported low levels of parental monitoring. In addition, among those with low levels of parental monitoring, communication with strangers was associated with an increased risk of reporting above average well-being. An association between communication with strangers online and mental well-being was not observed among those with medium-high levels of parental monitoring.

5.6.4 Overall evaluation of exploratory analyses to examine moderating effects

In summary, these additional analyses to examine the moderating role of gender, perceived social support from peers, perceived social support from family, and parental monitoring did offer some insight to supplement the stratified longitudinal analyses presented in Chapter Five. Firstly, these analyses enabled the testing of the interaction effects and enabled an examination of Hypotheses 6a, 6d, 7a, and 7d which was not possible in the stratified analyses. In addition, these findings provided some further evidence to support the unexpected findings observed in the stratified analyses as poorer outcomes related to cyberbullying involvement were observed for those with high levels of peer and family social support in the complete record follow-up data. There were some inconsistencies between the stratified analyses presented in Chapter Five and the analyses presented in Appendix 7. This is not surprising as the complete record follow-up analyses are based on cross-sectional data and use social media information collected at follow-up, while the analyses presented in Chapter Five (similar to the main analyses) are longitudinal and focus on associations between social media use at baseline and mental health outcome data at follow-up.

Given that the stratified analyses presented in Chapter Five are based on the same longitudinal sample as the main analyses, that they are better powered, and that they are based on longitudinal which makes them more in line with the study hypotheses than the complete record follow-up analyses, these stratified analyses have been retained in Chapter Five. However, the analyses in Appendix 7 support the need for further research into the moderating role of gender, perceived social support from peers and family, and parental monitoring in associations between social media use and adolescent mental health outcomes.

CHAPTER SIX

DISCUSSION

6 CHAPTER SIX: DISCUSSION

The main aim of this study was to examine longitudinal associations between social media use and adolescent mental health. The conceptualisation of social media use involved focusing on the frequency of adolescents' use of specific social media platforms (IM and SNS use), their involvement in cyberbullying, and the characteristics of their online networks (number of friends online and communication with strangers). The longitudinal associations between each of these social media characteristics and adolescent mental health in the form of depressive symptoms, social anxiety symptoms, and well-being have been examined. This chapter discusses the results in relation to previous empirical studies and theories on the association between social media use and adolescent mental health. The strengths, limitations and overall contributions of this study are also considered along with a discussion of possible future research directions and potential public health implications and possible interventions.

A summary of the main study findings in relation to the three mental health outcomes is provided in Table 65 below. This table summarises the findings reported in Chapter Four and depicts whether there was evidence for an association between each of the social media characteristics at baseline and adolescent mental at follow-up in this ORiEL cohort of 12 to 13 year old adolescents.

Table 65: Illustration of main study findings

MENTAL HEALTH AT FOLLOW-UP			
	Depressive symptoms	**Social anxiety symptoms**	**Mental well-being**
Baseline SNS use – Hypothesis 1			
Several times a day	☒	☒	☒
Every day or almost every day†			
Twice a week or less often	☒	☒	☒
Never	☒	☒	☒
Baseline IM use – Hypothesis 2			
Several times a day	☒	☒	☑ *Increased risk in fully adjusted models*
Every day or almost every day†			
Twice a week or less often	☒	☒	☒
Never	☒	☒	☒
Baseline cyberbullying involvement – Hypothesis 3			
Not involvement†			
Cybervictims	☑ *Increased odds in fully adjusted models*	☑ *Increased odds in fully adjusted models*	☑ *Increased risk (attenuated following adjustment for baseline well-being)*
Cyberbullies	☒	☒	☒
Cyberbully-victims	☑ *Increased odds in fully adjusted models*	☑ *Increased odds in fully adjusted models*	☑ *Increased risk (attenuated after adjustment for baseline well-being)*
Baseline network size – Hypothesis 4			
Does not have an SNS profile	☒	☒	☒
Up to 100 friends†			
100-300 friends	☒	☒	☒
300 friends	☒	☒	☒
Baseline communication with strangers online – Hypothesis 5			
No communication with strangers online†			
Online communication with strangers	☑ *Increased odds in fully adjusted models*	☑ *Increased odds (attenuated after adjustment for baseline social* anxiety symptoms)	☑ *Increased risk (attenuated after adjustment for baseline well-being)*

6.1 Frequency of Adolescent Social Media Use

This section focuses first on the prevalence of SNS and IM use among this cohort of early adolescents. Following this, the hypotheses in relation to associations between SNS and IM use and adolescent mental health are discussed in relation to the findings from this survey and links to previous literature.

6.1.1 Frequency of adolescent IM use and SNS use.

The current study adds to the literature by expanding our understanding of the pattern of adolescent IM and SNS use in the UK. Findings of the NCGM study (Livingstone et al., 2014) illustrated that, in 2013, 73% of 13-14 year olds reported having a profile on an SNS with 37% of the study participants reporting using SNS and 35% reporting using IM at least daily. Within the cohort of early adolescents participating in the ORiEL study, rates of IM use exceeded those of SNS use with over 70% using IM at least once per day compared to 47% using SNS at least once a day. Rates of SNS use were comparable between the ORiEL and NCGM studies though rates of IM use were much higher in the ORiEL study. Given that the studies took place with similar aged participants at a similar time it is unclear why these differences have emerged. One possibility is that the urban-centred sample characteristic of the ORiEL study may be more frequent IM users. In addition, 11% reported not using IM in the past month compared to 19% who reported not using SNS in the past month. Given that many SNS have a lower age limit; it is plausible that parents may restrict adolescent SNS use more than IM use given that there are age limit restrictions imposed by the sites themselves which parents may adhere to. This may explain the higher use of IM compared to SNS among this cohort. In addition, IM use tends to involve more active communication within dyads or small groups which may be attractive to early adolescents given the importance of close friendships during this stage (Bukowski et al., 1993). In contrast, SNS have a number of different functions some of which may be more linked to the promotion of weak-tie relationships (Subrahmanyam et al., 2008) which may be less attractive to early adolescents.

This study also examined gender differences in social media use in early adolescence. Previous studies have found mixed evidence for a gender difference in social media use. For example, Livingstone et al. (2014) reported findings related to the UK from the NCGM study which suggested higher levels of social networking site use

among males aged 9-16 compared to females; Espinoza and Juvonen (2011) reported higher levels of use by middle school females in the USA; while Livingstone et al. (2011b) did not find gender differences in adolescent reports of having a SNS profile among 9-16 year olds across 25 European countries (gender differences within countries not reported). Findings from the ORiEL study suggested that males use IM and SNS less frequently than their female peers. This suggests that there may be gender differences in social media usage patterns among early adolescents in an urban UK context.

Gender differences in the development of adolescent peer interactions have been established in the literature and suggest that, compared to males, females engage in greater discussion about emotional issues and intimate issues with their peers (Rapini, Farmer, Clark, Micka, & Barnett, 1990). Therefore, gender differences in social media use may be attributable to differences in the content of adolescents' online communication. Findings of the NCGM study (Livingstone et al., 2014) suggested that females aged 11+ report talking about more private things on the internet and reported finding it easier to be themselves on the internet than males which suggests that the content of online interactions may be important in determining level of use by males and females. Finally, there was not complete overlap between the IM and SNS use suggesting variation in adolescents' preferences for particular social media platforms and the popularity of particular social media platforms, as has been suggested in previous studies (Livingstone et al., 2014).

6.1.2 Frequency of social media use and adolescent mental health.

This study aimed to identify longitudinal associations between frequency of SNS use and IM use and adolescent mental health outcomes at one year follow-up. The first two related study hypotheses focused on testing these associations.

6.1.2.1 Evidence to support Hypothesis 1

The first hypothesis was that very high and very low levels of SNS use at baseline would be associated with poorer mental health (in the form of greater odds of depressive symptoms and social anxiety symptoms, and increased risk of below average well-being) at follow-up. Based on our study findings, we could not reject the null hypothesis as longitudinal associations between SNS use at baseline and mental health at follow-up were fully attenuated after adjustment for gender, ethnicity, SES, and school. In order to draw direct comparisons with previous empirical studies on this topic, analyses were also carried out on the baseline cross-sectional data. However, there were no cross-

sectional associations between SNS use and adolescent mental health, which is in contrast to findings from previous studies (Apaolaza et al., 2013; Pantic et al., 2012).

6.1.2.2 Evidence to support Hypothesis 2

The second hypothesis was that very high and very low levels of IM use at baseline would be associated with poorer mental health (in the form of greater odds of depressive symptoms and social anxiety symptoms, and increased risk of below average well-being) at follow-up. There was some support for this hypothesis. Those who reported using IM several times a day had greater risk of reporting below average well-being at one year follow-up than their peers who used IM every day or almost every day. However, contrary to our hypothesis, non-users of IM did not report poorer well-being than their peers who used IM every day or almost every day. The data did not provide evidence for an association between IM use and depressive and social anxiety symptoms. In addition, cross-sectional analyses were also carried out to enable comparison with previous literature. The data did not provide evidence for an association between IM use and well-being in the baseline cross-sectional analyses which was in contrast to the longitudinal findings. Previous studies have not looked specifically at associations between IM use and well-being though a study by Morgan and Cotten (2003) suggested that higher levels of IM use were associated with lower levels of depressive symptoms.

6.1.2.3 Discussion of findings related to Hypotheses 1 and 2

There were unexpected findings both in relation to the associations between SNS use and mental health and the associations between IM use and mental health. These hypotheses were based on existing media effects research and research on computer-mediated communication (CMC) and adolescent social relationships. Specifically, in line with media effects research, it was theorised that social media use is linked to heavy levels of overall internet use (Romer et al., 2013) which in turn is associated with poorer mental health outcomes (Bélanger et al., 2011; Romer et al., 2013). Additionally, from a CMC perspective, it was theorised that communication via social media is less beneficial to adolescents than face-to-face communication (Schiffrin et al., 2010). This was based on the argument that certain features of communication via social media distinguish it from face-to-face communication (Pea et al., 2012). These included links between social media use and increased levels of upwards social comparison (Chou & Edge, 2012; Kross et al., 2013), increased online disclosure which adolescents may later regret (Suler, 2004), and a reduction in social cues which may lead to online

disinhibition and more negative comments in an online context compared to face-to-face (Suler, 2004). Higher frequency of online interaction was also expected to correspond to a reduction in face-to-face conversation (Haddon & Vincent, 2014; Kraut et al., 1998). It was via these theorised mechanisms that it was expected that higher frequency of social media use would be negatively associated with adolescent mental health. IM use was associated with reports of below average well-being at follow-up so there was some evidence to support these theorised pathways. However, in terms of associations between SNS use and adolescent mental health, evidence to support Hypothesis 1 was not found in this study as the frequency of SNS use at baseline was not associated with mental health at follow-up.

Focusing first on associations between SNS use and adolescent mental health, one possible explanation for these unexpected findings is that frequency of SNS use is not associated with mental health among adolescents in East London and that previous research from cohorts in other countries such as the US (Kalpidou et al., 2011; Kross et al., 2013) and Spain (Apaolaza et al., 2013) may not be generalizable to this UK-based, or specifically East London-based, cohort of adolescents. This may be due to the fact that the ORiEL cohort represents a more ethnically diverse group of adolescents than has previously been examined in the literature. Additionally, the adolescents in the ORiEL cohort live in urban areas characterised by high levels of deprivation and previous research has not focused on adolescents from such highly deprived backgrounds which may have limited the ability to draw direct comparisons between our study and previous empirical research on this topic.

To the best of my knowledge, my study represents the first to examine the longitudinal associations between SNS and adolescent mental health. Distinguishing SNS from IM use was a strength of this study in comparison to previous research in this area; however, focusing on overall frequency of SNS use may not capture the adolescents' activities and specific experiences of using SNS (e.g. involvement in cyberbullying, communication with strangers, and communication with large networks of weak ties). The diversity in users' experiences may explain the absence of a main effect of intensity of SNS use on adolescent mental health (Best, Manktelow, & Taylor, 2014).

In addition, previous research on this topic has been limited by methodological factors. For example, many studies have been based on small sample sizes and may

have, therefore, had limited power to detect effects (Kalpidou et al., 2011; Kross et al., 2013). Previous research on this topic has also been limited by the use of cross-sectional research designs. During the course of this PhD, a systematic review on the association between social media use and adolescent mental health was published by Best et al. (2014). This review identified two longitudinal quantitative studies on frequency of social media use and adolescent mental health (Selfhout et al., 2009; van den Eijnden et al., 2008). However data for these studies was collected in 2003 and 2004, and thus both studies pre-date the invention of Facebook which raises questions as to their applicability to today's adolescents. Perhaps owing to methodological limitations such as these, previous findings in relation to associations between social media use and mental health have been mixed. Focusing specifically on my findings, while the results suggesting that SNS use at baseline is associated with adolescent mental health at follow-up contradict the study hypothesis, they are consistent with those of Jelenchick, Eickhoff, and Moreno (2013) who did not find evidence for an association between SNS use and depressive symptoms in their cross-sectional study of older adolescents in the USA (Mean age 18.9).

Turning to consideration of the possible theoretical explanations for the unexpected findings in relation to associations between IM use and adolescent mental health, these findings do offer some empirical and theoretical contributions to the field. To the best of my knowledge, this is the first study to directly examine associations between instant messaging use on adolescent well-being. The finding that those who report high intensity IM use are at an increased risk of reporting below average well-being one year later merits further study to replicate it and to test its generalisability to other populations. However, despite reporting poorer well-being than those who use IM every day or almost every day, these adolescents were not at increased odds of reporting depressive symptoms or symptoms of social anxiety at a follow-up one year later. These findings based on the cohort of early adolescents in the ORiEL study are inconsistent with previous longitudinal findings reported by van den Eijnden et al. (2008) who suggested that higher frequency IM use among (n=663) 12 to 13 year olds at baseline was associated with increased depressive symptoms at follow-up. However, this inconsistency may be related to the increase in IM use and IM accessibility attributable to the rise in smartphone use among adolescents (Livingstone et al., 2014) and the emergence of SNS which has taken place since the van den Eijnden et al. (2008) study data was collected in 2003/2004.

The findings of the ORiEL study suggest that IM use may be negatively associated with adolescent mental well-being which may indicate milder levels of distress which are not indicative of an increased risk of reporting symptoms of mental illness. Alternatively, those using IM at very high levels may lack self-confidence and be seeking reassurance from their peers via IM which might be independently associated with reports of below-average well-being (Clerkin, Smith, & Hames, 2013). In addition, Best et al. (2014) argued that higher levels of social media use may increase online exposure to harm among adolescents. It is plausible that the pathway between IM use and well-being is not direct but instead that high intensity IM use may increase adolescents' exposure to risks online and those subsequent risks may impact adolescent mental well-being.

It was also theorised that moderate levels of social media use may be beneficial for adolescents as non-use may signify exclusion from popular peer culture which may be negatively associated with mental health (Bélanger et al., 2011). It was theorised that adolescents might feel more comfortable disclosing information online which might be linked to increased intimacy in social relationships so some use of social media was expected to benefit adolescent mental health (Bessière et al., 2008; Morgan & Cotten, 2003; Suler, 2004). The data in this study, however, provided no support for this theory as there was no difference in mental health outcomes for those who never used SNS or IM compared to their peers who used SNS or IM every day or almost every day. It is possible that theory suggesting negative mental health outcomes related to non-use may be more applicable to older adolescents and early adults or to specific sub-groups of adolescents (e.g. adolescents who find face-to-face communication particularly anxiety provoking).

6.1.2.4 Implications of findings related to Hypotheses 1 and 2

Taking the findings in relation to the mental health impact of adolescent SNS and IM use together, these findings can inform future research in this field. These longitudinal results from a large early adolescent cohort suggest that frequency measures – even when specific to particular types of social media use – may not be directly associated with adolescent mental health outcomes. This is in support of recent arguments which have emerged suggesting that we need to focus on specific ways in which adolescents' use social media (Best et al., 2014). The mental health outcomes related to SNS and IM use were explored separately in this study as their communication functions were expected to differ for adolescents. IM usually involves

direct, active communication between dyads or groups of close friends (Selfhout et al., 2009) while, as a social media platform, SNS offer a wider range of social functions, usually within a larger audience of weaker-ties (Manago et al., 2012). As a result, IM primarily involves sending messages and actively engaging in real-time communication online (Pujazon-Zazik & Park, 2010). While SNS use can involve real-time communication with others, SNS also tend to have other functions in terms of self-presentation whereby users can upload and circulate photos or other media within their social network. SNS can also be used passively to view media and other content uploaded by others without actively communicating with others (Ellison, Steinfield, & Lampe, 2007). Future studies should consider focusing on the extent to which participants are active users (i.e. users who update their status or upload content regularly) or passive users (i.e. users who mostly use SNS to look at others' content) of SNS (Ryan & Xenos, 2011) as active and passive use of social media may show different associations with adolescent mental health.

Measures of individual tendencies towards social comparisons and self-disclosure via social media may be particularly useful in terms of identifying links to adolescent mental health. Active social media users may disclose more personal information online which may leave them vulnerable to victimisation (Suler, 2004), while passive users may be more lonely (Ryan & Xenos, 2011). In addition, passive use in particular may be linked to repeated exposure to friends' positive self-presentation online. This may lead adolescents to engage in more upward social comparisons (Blomfield Neira & Barber, 2014) which may negatively impact their mental health (Chou & Edge, 2012). Future studies may also be strengthened by examining compulsive social media use and the intrusiveness of SNS in adolescents' lives (e.g. the extent to which school life, sleep, and home life are disrupted because of social media use (Espinoza & Juvonen, 2011)) as such measures may assist in identifying ways in which other aspects of adolescents' lives are displaced by their use of social media which in turn may negatively influence adolescent mental health. As the first longitudinal study to focus on links between SNS and IM use and adolescent mental health, and the first-UK based study on this topic, the findings of this study have enabled me to test the applicability of theories and existing empirical findings to adolescents in the UK.

The unexpected findings in relation to associations between SNS and IM use and adolescent mental health lend some support to the claim that it may be the function

rather than the frequency of social media use which influences adolescent mental health. Cyberbullying involvement was identified in the literature review as one particular type of online behaviour which may diminish the quality of adolescent social relationships and correspondingly, their mental health. Findings of this study in relation to longitudinal associations between cyberbullying involvement and adolescent mental health add to our understanding of the potential role of cyberbullying as a risk factor for future adolescent mental health problems.

6.2 Cyberbullying Involvement

In this section, the prevalence of cyberbullying involvement among this early adolescent cohort is discussed first and is followed by a discussion of the findings related to hypotheses of associations between cyberbullying involvement and adolescent mental health.

6.2.1 Prevalence of cyberbullying involvement.

This study provided evidence relating to the prevalence of cyberbullying among this multi-ethnic cohort of adolescents living in East London areas characterised by high levels of deprivation. The findings of this study suggested that cyberbullying prevalence rates were high in this study with 42.2% of participants reporting involvement in cyberbullying in the previous 12 months; one fifth of the total sample were involved as cyberbully-victims. The high prevalence of cyberbullying involvement reported may be due to the lenient frequency criterion (at least once or twice in the past 12 months) but the findings discussed below suggest that cybervictimisation – even at low levels – may be a risk factor for future adolescent mental health problems. These rates of cybervictimisation are consistent with other studies using similar measures (Ybarra et al., 2007).

In addition, it was found that cyberbullying involvement was significantly greater among males. Tokunaga (2010) highlighted the inconsistent research findings relating to gender involvement in cyberbullying. My finding that males are more likely to be involved in cyberbullying is less common in the literature (Calvete, Orue, Estévez, Villardón, & Padilla, 2010). The cyberbully-victim group is not always included in cyberbullying research as many studies focus on either cybervictimisation or cyberbullying without examining the overlap between the two. In my study, males were at greater risk of being cyberbully-victims compared to females and this may explain the unexpected gender difference obtained in this study. The cyberbully-victim group

should be examined as some studies suggest that this group may represent the largest group involved in cyberbullying (Gamez-Guadix et al., 2013).

6.2.2 Cyberbullying involvement and adolescent mental health.

This study aimed to identify longitudinal associations between involvement in cyberbullying at baseline and adolescent mental health outcomes at one year follow-up. The third study hypothesis focused on testing these associations.

6.2.2.1 Evidence to support Hypothesis 3

Based on findings in relation to traditional bullying and the ways in which features of cyberbullying are believed to have a negative influence on adolescent mental health, the third hypothesis for the current study was that those involved in cyberbullying at baseline as a cybervictim, cyberbully, or cyberbully-victim would report poorer mental health at follow-up in the form of depressive symptoms, social anxiety symptoms, and mental well-being. The results of the longitudinal analyses supported this hypothesis as there was an increase in odds of reporting depressive symptoms and social anxiety symptoms at follow-up for those who reported being a cybervictim or cyberbully-victim at baseline compared to their uninvolved peers, even after adjusting for covariates (gender, ethnicity, SES, and school), and baseline mental health. Both cybervictims and cyberbully-victims were also at increased risk of reporting below average mental well-being at follow-up relative to their uninvolved peers. However, the findings for mental well-being were attenuated after adjusting for baseline well-being. The hypothesis that cyberbullies would be at increased odds of reporting depressive symptoms or social anxiety symptoms at follow-up or at increased risk of reporting below average well-being at follow-up, was not supported. However, it is possible that perpetration of cyberbullying is more strongly associated with externalising than internalising symptoms among early adolescents as is discussed in the next section.

6.2.2.2 Discussion of findings related to Hypothesis 3

The literature review highlighted evidence for an association between peer-victimisation and negative mental health outcomes including increased depression, anxiety, and loneliness compared to non-victimised peers (Hodges & Perry, 1996). Adolescents involved in physical, verbal, and relational forms of bullying (victims and bully-victims in particular) have also been found to have higher depression scores than those not involved in bullying. However, much less is known about associations between cyberbullying and adolescent mental health. Existing longitudinal research on

mental health outcomes related to adolescent cyberbullying involvement is limited (Livingstone & Smith, 2014) though findings related to depressive symptoms are consistent with those of Gamez-Guadix et al. (2013), whereby baseline cybervictimisation was associated with depressive symptoms at six-month follow-up. The current study extends the findings of Gamez-Guadix et al. (2013) by adjusting the association for individual factors (gender, ethnicity, SES, and school). While Machmutow et al. (2012) found an association between being a victim of cyberbullying and increased depressive symptoms at six-month follow-up, this association was not sustained after adjusting for baseline depressive symptoms. However, the study by Machmutow et al. (2012) may have lower power than this study to detect an effect in the adjusted model given its smaller sample size of n=667. In addition, a three year longitudinal study carried out in the US by Rose and Tynes (2015) suggested a reciprocal relationship between cybervictimisation and symptoms of depression and anxiety, though perpetration of cyberbullying was not measured and there was no adjustment for demographic factors in this study of 559 US adolescents in grades 6 to 12 (aged approximately11-18 years).

In terms of social anxiety, research on traditional bullying has emphasised the need to explore links with adolescent social anxiety given that stressful environments including peer victimisation are believed to be one of the main contributors to the development of this disorder during adolescence (Storch, Masia-Warner, Crisp, & Klein, 2005). The finding that cybervictims and cyberbully-victims had greater odds of reporting social anxiety symptoms over time compared to their uninvolved peers extends previous cross-sectional findings (Juvonen & Gross, 2008) and offers support for continued research into the impact of peer victimisation online and adolescent social anxiety. Our findings are consistent with a recent study which found a significant association between cybervictimisation and social anxiety symptoms six weeks later (Landoll, La Greca, Lai, Chan, & Herge, 2015), though that effect was attenuated after adjusting for comorbid depressive symptoms.

Few previous studies have examined associations between cyberbullying and adolescent well-being. Moore et al. (2012) found that cyberbullies and cybervictims reported significantly lower life satisfaction than non-cyberbullies and non-cybervictims in their cross-sectional study of US adolescents. The study by Moore et al. (2012) did not distinguish a cyberbully-victim group which may explain the discrepancy between their finding that cyberbullies report lower life satisfaction and our finding that

cyberbully-victims but not cyberbullies were at greater risk of reporting below-average well-being compared to uninvolved peers. More recently, it has been suggested that perpetration of cyberbullying is not associated with well-being in a cross-sectional study of early adolescents in the UK (Fletcher et al., 2014). Fletcher et al. (2014) found that perpetration of cyberbullying was associated with conduct problems and hyperactivity but not with peer problems or lower mental well-being in analyses adjusted for gender, ethnicity, and SES. This is consisted with the findings reported in this PhD as involvement in cyberbullying as a cyberbully was not associated with well-being at follow-up. However, there was no cyberbully-victim group in this study by Fletcher et al. (2014) so it was not directly comparable to this PhD study.

Notably, my findings in relation to associations between cyberbullying and mental well-being were attenuated after adjusting for baseline well-being. This may be largely attributed to the relative stability in the well-being measure over time and may present an over-adjustment of the final model. As there was little change in mental well-being scores over time it is possible that this construct may be relatively stable and represent more of a trait than a state (Ormel, 1983). Personality (e.g. extraversion) and genetic factors (e.g. heritability) have been found to be associated with well-being which offers some support for this top-down theory of mental well-being (Diener, 2013).

Most of the existing studies of cyberbullying have focused on cybervictimisation exclusively without looking at cyberbullying perpetration (Bannink et al., 2014; Landoll et al., 2015; Machmutow et al., 2012; Reed, Nugent, & Cooper, 2015). The exploration of cyberbullying involvement in terms of perpetration, victimisation and the overlap between the two is a strength of this study as it highlights that cybervictims and cyberbully-victims may experience similarly negative outcomes. Our results suggest similar effect sizes for cybervictims and cyberbully-victims in terms of depression, social anxiety, and mental well-being. This is in contrast with Gamez-Guadix et al. (2013) whose findings suggested more negative outcomes for cyberbully-victims. It is possible that this discrepancy may be attributed to participant age differences (13-17 years at baseline in the Gamez-Guadix et al. (2013) study compared to 12-13 years in this study). For example, Campbell et al. (2013) highlighted the research literature suggesting that older adolescents tend to report higher levels of perpetration of cyberbullying than traditional forms of bullying. Higher frequency of perpetration of cyberbullying among older adolescents may lead to more pronounced negative effects

on mental health for cyberbully-victims. In addition, while effect sizes for associations between being a cybervictim or a cyberbully-victim and mental health are similar in this study, it is possible that different interventions may be required for those who are targeted by cyberbullying and those who both perpetrate and are targeted by cyberbullying.

There are a number of ways in which cyberbullying is different from traditional forms of bullying. Notably, the permanence of online messages means a single act of online harassment may be repeatedly viewed or distributed by others. In addition, online disinhibition may desensitise perpetrators of cyberbullying as they cannot directly see victims' reactions to their comments, and they may make more harsh or negative comments behind the screen than they would face-to-face (Suler, 2004). Unlike face-to-face conflict which tends to occur in schools cyberbullying also tends to occur in online environments lacking adult supervision and it is not restricted to any specific geographical location, possibly preventing those victimised from escaping its impact (Hinduja & Patchin, 2007). However, while traditional and cyberbullying are notably different, it was not possible to adjust the models in this study for traditional bullying involvement to ascertain the extent to which the influence of cyberbullying involvement on mental health is independent of traditional bullying involvement.

Some sensitivity analyses were carried out using the single bullying item available – this item asked adolescents whether they had ever been bullied in their lifetime which was a very limited means of adjusting for traditional bullying involvement. Notably, the single item was not directly comparable to the cyberbullying measure. The single "ever bullied" item addressed victimisation only and not perpetration. This item also asked about bullying in the lifetime rather than a time frame more comparable to the 12 month cyberbullying measure. As the item simply referred to "bullying" it is unclear whether adolescents are responding in reference to physical, verbal, relational bullying or indeed instances of cyberbullying. After adjustment for this item, effect sizes in the main analyses were reduced but the associations were sustained providing some evidence, despite these limitations, regarding associations between cyberbullying involvement and adolescent mental health independent of other forms of victimisation.

Findings of this study suggest that those who are exclusively perpetrators of cyberbullying (and are not targeted by cyberbullying) may be less prone to internalising

problems, as reports of depression, social anxiety, and well-being in this group are similar to reports of those uninvolved in cyberbullying. However, perpetration of cyberbullying may show greater associations with externalising problems such as aggression, substance abuse, and delinquency: outcomes which have not been the focus of this study. There is some support in the literature for this. For example, Fletcher et al. (2014) found that, cross-sectionally, compared to uninvolved adolescents, cyberbullies were more likely to report conduct problems and hyperactivity but they did not report poorer well-being. It is plausible that those in the cyberbully-victim group may also experience externalising problems, another justification for distinguishing this group in future research studies.

6.2.2.3 Implications of findings related to Hypothesis 3

The findings of this study in relation to longitudinal associations between cyberbullying and adolescent mental health contribute to the literature on this topic in a number of important ways. At the time of beginning this PhD there were no longitudinal studies on this topic – a critical gap given that traditional forms of bullying have been identified as a key modifiable risk factor for mental health (Scott, Moore, Sly, & Norman, 2014a) and there has been growing concern among researchers and the general public given the characteristics of cyberbullying which distinguish it from traditional forms of bullying and may perhaps make its mental health impact more severe (Kozlowska & Durheim, 2014a). While some longitudinal papers on this topic have been published during the lifetime of this project, the findings from this study make a number of contributions.

This is the first study to test whether cyberbullying involvement is longitudinally associated with poorer mental health in a UK sample, specifically a sample of adolescents in East London. The local data is of high importance to public health policy makers in terms of identifying ways to efficiently and effectively distribute finite health resources to those most in need (Kirkbride, 2015). In addition, reliance on international or even national data may underestimate the extent of mental ill-health in urban communities and as such local mental health data is essential if mental health problems are to be targeted and treated most effectively (Hatch et al., 2012). Notably, this study is based on a sample of adolescents in East London so findings may not generalise to the whole of the UK but the local data from an urban context characterised by high levels of deprivation emphasises that characteristics of social media use may influence the mental health of adolescents among adolescents living in similar environments across the UK.

Current research on the impact of cyberbullying has involved an exploration of a limited number of mental health outcomes. This study advances research in the field of cyberbullying by examining prospective associations between cyberbullying involvement and three domains of adolescent mental health – depression, social anxiety, and mental well-being. The possibility of specificity in the effects of cyberbullying on adolescent mental health means that studies which limit findings to a single mental health outcome may be problematic. For example, the absence of an effect on one mental health domain may lead to the false assumption that no association would exist for other mental health outcomes (Schilling, Aseltine, & Gore, 2007). For example, cyberbullying perpetration was not associated with reports of internalising mental health problems in this study but this group may report externalising problems which were not the focus of this study.

Lastly, the recent Good Childhood Report (Pople, Rees, Main, & Bradshaw, 2015) suggests that children in England have relatively low levels of subjective well-being compared with children from 14 other nations. The authors of this report emphasise that bullying should always be taken seriously and effectively tackling bullying could have a considerable positive impact on young people's well-being (Pople et al., 2015). If cyberbullying is to be taken seriously, more research is needed in order to identify adolescents at risk of involvement, to identify those who experience most detrimental outcomes, and to identify effective interventions to tackle this issue. While involvement in cyberbullying as a cybervictim or cyberbully-victim is associated with poorer mental health outcomes in this study, future studies should focus on the individual, social, and environmental factors which protect adolescents involved in cyberbullying from experiencing poorer mental health outcomes.

In summary, cyberbullying may represent a key feature of adolescent online social relationships which is linked to poorer mental health outcomes in terms of depressive symptoms, symptoms of social anxiety and below-average well-being.

6.3 Characteristics of Adolescents' Online Networks

This section focuses first on a discussion of the study findings in terms of the characteristics of adolescents' online networks, including the number of contacts they have online and whether or not they communicate with strangers. Following this, findings related to hypotheses of associations between online network characteristics and adolescent mental health are discussed.

6.3.1 Characteristics of adolescents' online networks.

This study also provided information as to the size of adolescents' online networks and the prevalence of online communication with strangers among adolescents of this age. Findings of this study revealed that, at baseline, 34.4% of participants reported having up to 100 friends on their most used SNS while 52.5% reported over 100 friends. A fifth of participants reported having over 300 friends on their most used SNS. These figures are comparable to those reported by UK adolescents in the Net Children Go Mobile Study (Livingstone et al., 2014) wherein 47% of 13-14 year olds reported having over 100 friends on their most used SNS. Future research should examine adolescent motivations for such large networks of online friends. It may be that adolescents are motivated by the desire to appear popular (Espinoza & Juvonen, 2011; Manago et al., 2012) or perhaps adolescents with large online networks are more extroverted and are motivated by high levels of social stimulation (Oldmeadow, Quinn, & Kowert, 2013). However, the results of our study did not provide evidence for gender differences in reported network size. Livingstone et al. (2014) found that overall 44% of males (aged 9-16) reported having over 100 friends compared to 22% of females the same age. Our study suggests that gender differences such as those suggested in the Livingstone et al. (2014) study may not be present amongst younger adolescents.

In terms of communication with strangers, 24.7% of participants in our study reported communicating with strangers online in the past 12 months, with males more likely than females to talk to people they do not know in person online. Again, these findings are similar to those reported in the NCGM study (Livingstone et al., 2014) wherein 25% of 13-14 year olds reported communication with strangers in the previous 12 months. With one in four adolescents reporting talking to strangers online, these findings suggest that communication with individuals not known in real life is widespread and not a marginal behaviour among these 12 to 13 year old early adolescents.

6.3.2 Size of online network and adolescent mental health.

This study aimed to identify longitudinal associations between the size of adolescents' online social networks use and mental health outcomes at one year follow-up. The fourth study hypothesis focused on testing these associations.

6.3.2.1 Evidence to support Hypothesis 4

The fourth study hypothesis was that those who had very high numbers of friends online at baseline would report better mental health (in the form of lower odds

of depressive symptoms and social anxiety symptoms, and decreased risk of below average well-being) at follow-up compared to those with average sized networks of online friends. Findings of the longitudinal analyses suggested that those with over 300 friends had increased odds of reporting depressive symptoms at follow-up than their peers with up to 100 friends. However, this association was attenuated after adjustment for gender, ethnicity, SES, and school. The longitudinal analyses did not suggest an association between size of adolescents' online networks and social anxiety or well-being. The hypothesis that self-reported online network size is not associated with adolescent mental health one year later was not supported by the data.

Results of the baseline cross-sectional analyses suggested that those with over 300 friends had increased odds of reporting depressive symptoms compared to their peers with up to 100 friends, even after adjusting for gender, ethnicity, SES, and school. This cross-sectional finding is more in line with theories suggesting that social networking sites may engender an orientation toward popularity and large networks at the expense of close, intimate, supportive relationships (Manago et al., 2012). Online network size may not be fully representative of adolescents' available social support and as such larger online networks may not fulfil adolescents' emotional needs, a finding which is in line with exploratory results of a small-scale study of US undergraduates (n=70) by Kalpidou et al. (2011). The longitudinal results suggest, however, that associations between adolescents' online network size and future mental health outcomes may be largely accounted for by gender, ethnic, and SES differences in online network size.

6.3.2.2 Discussion of findings related to Hypothesis 4

Research examining associations between online network size and adolescent mental health is rare, with no longitudinal papers on this topic identified. It was theorised that the size of adolescents' online networks would be a marker of their available social support. In turn, those with higher levels of social support, as indicated by their larger online network size, were expected to report better mental health over time. The unexpected findings of this study were in contrast with previous cross-sectional empirical research which found support for a "more friends the better" heuristic (Donath & Boyd, 2004; Nabi et al., 2013b). Large networks of friends online are likely to include both close friends and also more distal, weak-ties with whom adolescents do not have a social relationship (Manago et al., 2012) and it was posited that larger networks of friends might enhance adolescents' perceptions of their

popularity among their peers (Ahn, 2011; Manago et al., 2012). This theoretical association was not supported by the findings of this study.

Bukowski et al. (1993) emphasised two dimensions of peer relationships that are important – popularity and friendship. Popularity refers to the extent to which an individual is accepted by the peer group and is linked to a sense of belonging while friendship is linked to a sense of loyalty, affection, and intimacy characteristic of close relationships (Furman & Robbins, 1985). Results of a study from Bukowski et al. (1993) suggested that friendships are more important than popularity during early adolescence and that associations between popularity and adolescent psychological adjustment are mediated by perceptions of friendship. This may explain why our findings are incongruous with previous research on the association between friendship network size and adolescent mental health. The majority of previous studies have focused on university-aged samples rather than early adolescents. For late-stage adolescents attending university, large networks of weaker ties may be positively related to mental health as these large networks may represent a source of bridging social capital which allows late-stage adolescents to maintain relationships with former school friends regardless of geographical location (Ellison et al., 2007). During early adolescence, however, the development of close friendships rather than weak ties is of central importance in terms of psychological adjustment (Sullivan, 1953).

Alternatively, it is also plausible that university-aged students are better able to estimate their network size online. Adolescents as young as those in the current study may find self-reporting of network size more challenging and corresponding inaccuracies in network sizes reported may offer an alternative explanation for the lack of evidence for an association between network size and adolescent mental health reported here. Early adolescents such as those in this study may also be more influenced by social desirability when estimating their network size and thus may have over-estimated the size of their online networks. In addition, it is possible that the reference group of "up to 100 friends" used in this measure represents a wide range and so we are not getting at those participants with very small networks as we had to collapse the lower categories in order to run the imputation.

6.3.2.3 Implications of findings related to Hypothesis 4

When conducting research focusing on social support received online by early adolescents it may be more developmentally appropriate to focus on measures of perceived social support and close friendships (both online and offline) than on

measures of popularity or support within weak-tie relationships. Measurement of perceived social support within close relationships may be most informative if focused specifically on perceived social support in online and offline contexts. Indeed, while popularity is important, previous research has emphasised the importance of close dyadic friendships as directly influencing feelings of loneliness and depression (Nangle, Erdley, Newman, Mason, & Carpenter, 2003). SNS may be less useful for creating or maintaining bonding social capital (Ellison et al., 2007). As such, large online networks may not be as beneficial to indices of mental health during this early adolescent stage.

In summary, there was limited association between the size of adolescents' social networks and their mental health. This suggests that online social network size may not be representative of the actual social support available to adolescents. Future studies should consider more objective measures of online network size as it may be difficult for adolescents to estimate and self-report network size and this measure may be influenced by social desirability.

6.3.3 Communication with strangers and adolescent mental health.

This study also aimed to identify longitudinal associations between online communication with strangers at baseline and adolescent mental health outcomes at one year follow-up. The fifth study hypothesis focused on testing these associations.

6.3.3.1 Evidence to support Hypothesis 5

The fifth hypothesis was that those who reported communicating with strangers online at baseline would report poorer mental health (in the form of greater odds of depressive symptoms and social anxiety symptoms, and increased risk of below average well-being) at follow-up. The results of the longitudinal analyses were consistent with this hypothesis. Those who communicated with strangers at baseline had increased odds of reporting depressive symptoms at follow-up than their peers who did not communicate with strangers, even after adjusting for gender, ethnicity, SES, school, and baseline depressive symptoms. In the fully adjusted models, communication with strangers at baseline was associated with increased odds of reporting symptoms of social anxiety and increased risk of reporting below average well-being at follow-up. However, associations with social anxiety and well-being were attenuated after adjustment for baseline symptoms of social anxiety and baseline well-being respectively. Given associations between previous and current mental health it is plausible that adjustment for baseline mental health represents an over-adjustment in these models.

6.3.3.2 Discussion of findings related to Hypothesis 5

Previous research suggested that online communication is associated with poorer mental health outcomes when that communication is with strangers (Bessière et al., 2008; Valkenburg & Peter, 2007b). The results of this study supported this hypothesis as online communication with strangers was associated with depressive symptoms at follow-up even after adjustment for baseline depressive symptoms. This suggests that online communication with strangers may have a negative influence on adolescents' future mental health. Online communication may reduce time available for face-to-face communication (Haddon & Vincent, 2014) and when that communication is with strangers rather than with real-life friends it may have a negative impact on the quality of adolescents' close friendships which may explain this negative association (Lee & Stapinski, 2012). Adolescents may feel more disinhibited when communicating with strangers than when communicating with known others and as such, communication with strangers may also be characterised by more negative interactions (Subrahmanyam & Greenfield, 2008a). Negative or coercive online interactions may have a more negative influence on adolescent mental health (Mishna et al., 2009; Ybarra et al., 2005) which represents another possible explanation for the association between online communication with strangers and adolescent depression.

For those who are lonely or isolated, however, online communication may help to fulfil needs for affiliation and belonging (Ahn, 2011; Pierce, 2009). However, online communication online with strangers, may not enhance offline relationships and instead may exacerbate avoidance of face-to-face communication with offline friends (Lee & Stapinski, 2012). The finding that online communication with strangers was associated with social anxiety symptoms at follow-up offered some empirical support for this theorised association. However, this association was attenuated after adjusting for baseline symptoms of social anxiety. It may be that those communicating with strangers online are more socially isolated (Subrahmanyam & Greenfield, 2008a) or socially anxious than their peers and so the association between communication with strangers. Indeed, the findings of this study suggested that the association between online communication with strangers and social anxiety at follow-up was attenuated after accounting for adolescents' baseline levels of social anxiety.

6.3.3.3 Implications of findings related to Hypothesis 5

Notably, the type of communication occurring with these strangers is not clear from this study. Future research should examine with whom this communication is

occurring. These strangers may be friends of friends, peers with similar interests (e.g. in a particular music group, sport, or game), and may be a similar age or could be older adolescents or adults. In addition, the motivations for communication may vary considerably from communication for information purposes (e.g. to discuss a particular music group or sport), for entertainment purposes (e.g. during an online game), or romantic purposes (e.g. online dating). Associations between online communication with strangers and adolescent mental health may be more nuanced and vary according to the motivations for communicating with strangers (Wolak et al., 2008).

In addition, future studies should consider examining longitudinal associations between communication with strangers online and externalising symptoms. Some previous cross-sectional studies have suggested that adolescents who engage in online risk taking are also prone to externalising or conduct problems (e.g. carrying a weapon, suspensions for school) offline (Dowell et al., 2009). Dowell et al. (2009) argued that adolescents who engage in online risk-taking tend to take multiple risks online (including communication with strangers, posting personal information online, and cyberbullying). Mitchell, Finkelhor, Wolak, Ybarra, and Turner (2011) also found that those who engaged in rule-breaking behaviour online were more likely to communicate with strangers online, a finding which suggests that these online communications with strangers may be linked to other types of risk-taking and indeed conduct disorder among adolescents. Future studies should also consider focusing on the characteristics of adolescents who communicate with strangers online as it may be that these children are more vulnerable due to issues related to psychosocial development which may lead them to seek out communication with unknown others online in order to fulfil needs for affiliation which are not met in their relationships with their known peers.

6.4 Exploratory Analyses: Gender, Peer Support, and Family Relationships

Two additional research questions were identified for this study: how might the pathways from characteristics of social media use to adolescent mental health differ for males and females? And what role might peers and parents play in buffering or exacerbating the impact of the characteristics of adolescents' social media use on their mental health? The analyses examining the role of gender, peer support, and family relationships in associations between social media use and adolescent mental health are exploratory in nature. Due to limitations relating to the multiple imputation, it was not possible to statistically test for interaction effects. Therefore, these exploratory analyses

were carried out by stratifying results by variables of interest as potential moderators (gender, peer support, family support, and parental monitoring).

Gender, perceived peer support, family support, and parental monitoring were examined only where main effects were found - between IM use, cyberbullying involvement, and online communication with strangers, and the adolescent mental health domains. Specifically, the exploratory analyses in terms of gender have been restricted to include hypotheses 6b, 6c, and 6e and the exploratory analyses in terms of peer and family factors have been restricted to hypotheses 7b, 7c, and 7e. Each of these hypotheses are re-examined below in relation to the exploratory findings. Hypotheses 6a and 7a were specific to associations between SNS use and adolescent mental health and hypotheses 6d and 7d were specific to associations between network size and adolescent mental health. Neither SNS nor network size was associated with adolescent mental health in the main longitudinal analyses and as such these associations have not been explored in the stratified analyses.

These exploratory analyses are limited by the reduced power to detect effects in the stratified analyses. In addition, it is important to acknowledge that we have not corrected for multiple testing and so it is possible that some findings are spurious given the number of tests carried out. The sample size across imputed datasets also varies slightly and so Rubin's rules are combining findings from slightly different size groups of individuals, though the amount of variation is small. Despite these limitations, these analyses do offer new information as to the possible moderating role of gender, perceived peer and family support, and parental monitoring in associations between characteristics of social media use and adolescent mental health and they enable a discussion of possible theoretical ways in which these potential moderators might impact these associations. These analyses also point towards future studies which would improve our understanding of the groups most negatively impacted by their experiences using social media; information which is vital if effective, efficient interventions are to be designed and targeted to the right individuals.

Finally, a key contribution of these exploratory analyses lies in their methodological contribution. Review papers on this topic often emphasise the need to conduct longitudinal studies and to identify factors modifying effects (Livingstone & Smith, 2014; Nixon, 2014) but this study elucidates some key methodological challenges which have not been previously acknowledged in the literature. Adolescent

survey data often contains large amounts of missing data which is best dealt with using multiple imputation methods. In practice, however, imputing interaction variables in the longitudinal adolescent datasets needed to test moderating effects is difficult using software programs currently available. The current study has a relatively large sample size for a longitudinal adolescent mental health research study. Once analyses are stratified however, the power to detect effects is greatly reduced and so robust testing of moderating effects may only be possible in much larger cohort datasets. Each of these issues represents a caveat which should be indicated to other researchers in the field.

6.4.1 Gender.

A secondary aim of this study was to investigate the way in which the associations between characteristics of social media use to adolescent mental health differ for females and males.

6.4.1.1 IM use

Based on Hypothesis 6b it was posited that the association between high frequency IM use and below average well-being would be stronger for females. Focusing on associations between IM use and below average well-being, once the gender stratified analyses were adjusted for ethnicity, SES, and school the data did not provide evidence for an association between IM use at baseline and below average well-being at follow-up for males or females and the estimated effect sizes were similar for males and females in these lower-powered stratified analyses. The main effect, which suggested that those who use IM several times a day had greater risk of reporting below average well-being than those who use IM every day or almost every day may not be moderated by gender.

Previous research focusing on frequency of online communication has suggested that females report discussing more intimate, private issues than males when communicating via social media (Livingstone et al., 2014). This was expected to increase females' exposure to interpersonal stressors and co-rumination which was expected to lead to poorer mental health outcomes (Hamilton et al., 2014). However, the results of this study did not provide evidence to support this. The lack of evidence for an association between IM use and well-being in the stratified analyses also suggests that larger sample sizes may be needed to robustly examine gender differences in this association.

6.4.1.2 Cyberbullying involvement

Hypothesis 6c was that associations between cyberbullying involvement and poorer adolescent mental health would be stronger for females. The stratified results offered some support for this hypothesis. The results of the stratified analyses suggested that the association between involvement in cyberbullying as a cyberbully-victim and social anxiety symptoms at follow-up may be stronger among females than males. This hypothesis was not supported in terms of gender differences in associations between cyberbullying involvement and depressive symptoms or below average well-being.

In terms of associations between cyberbullying and mental health, there has been little research on this topic. The findings of a recent longitudinal study by Bannink et al. (2014) suggested that cybervictimisation was associated poorer mental health reports (based on the Strengths and Difficulties Questionnaire) for females only. However, the Bannink et al. (2014) study did not distinguish cybervictims from cyberbully-victims. The findings of my study suggested that female cyberbully-victims may have greater odds of reporting social anxiety at follow-up than males but did not suggest a gender difference for cybervictims. Distinguishing cybervictims from cyberbully-victims may be important in identifying gender differences in associations between cyberbullying involvement and adolescent mental health outcomes. As gender differences in associations between cyberbullying involvement and adolescent mental health were suggested for social anxiety but not for depressive symptoms or mental well-being, these findings suggest that the modifying effects of gender may differ depending on the specific mental health outcome being studied. Further research is needed to replicate these findings using larger samples with greater power to detect effects.

6.4.1.3 Communication with strangers online

Hypothesis 6e was that associations between communication online with strangers and poorer adolescent mental health would be stronger for females. The data did not provide evidence to support this hypothesis: an examination of the effect sizes estimated for males and females and their confidence intervals did suggest gender differences in the associations between online communication with strangers and adolescent mental health.

Previous studies have not examined the moderating effect of gender in associations between communication online with strangers and adolescent mental health. It was expected that communication within close relationships would be more important among females (Rose & Rudolph, 2006) and as such communication with

weak ties, or specifically strangers in this case, would be have a more negative influence on females' mental health (van den Eijnden et al., 2008). However, this theorised gender difference was not supported by the results of the stratified analyses.

6.4.1.4 Implications

Gender differences in associations between the characteristics of social media use and adolescent mental health outcomes may depend on the mental health outcome being measured and on the characteristics of social media use being examined. The stratified analyses suggest that the association between being a cyberbully-victim and reporting social anxiety at one year follow-up may be stronger among females. This should be tested robustly by testing the interaction in future studies. This finding suggests that gender moderation may differ depending on whether adolescents are involved in cyberbullying as cybervictims or cyberbully-victims. Intervention efforts to improve mental health of cyberbullying-victims may be particularly important for females. Future studies should examine multiple mental health outcomes, including externalising outcomes as these have not been examined in this study. Studies which find no gender differences should be cautious in over-generalising such findings to mental health outcomes other than those directly examined and researchers should be mindful of the power they might have to detect such gender differences.

6.4.2 Perceived social support and parental monitoring.

Another secondary aim of this study was to investigate the role peers and parents might play in buffering or exacerbating the impact of the characteristics of adolescents' social media use on their mental health. In order to examine this, perceived social support from peers and family, and parental monitoring were identified as potentially important moderating variables in associations between characteristics of social media use and adolescent mental health. This aim was based on consistent existing empirical research which suggests that perceived social support is associated with mental health benefits (Stansfeld, 2005), research which emphasises that peer relationships are associated with adolescent health and development (De Goede et al., 2009; Sweeting, Young, West, & Der, 2006), and research which has highlighted the importance of parental factors in adolescent mental health and behavioural outcomes (Barnes & Farrell, 1992; Repetti et al., 2002).

In terms of social support, there is evidence to suggest that adolescents receive social support from different sources (Furman & Buhrmester, 1985) with support from family very important but support from peers of increasing importance during

adolescence (Marini, Dane, Bosacki, & Cura, 2006; Rothon et al., 2011). In addition, in terms of research focusing on the importance of family factors, two facets of parenting – support and control – have been identified as important factors which may influence adolescent outcomes (Barnes & Farrell, 1992). Hypotheses 7a, 7b, and 7c were related to this final study aim of exploring the role of peer and family factors in associations between characteristics of social media use and adolescent mental health.

6.4.2.1 IM use

Hypothesis 7b was that the association between non-use or very high levels of IM use at baseline and poorer mental health outcomes at follow-up would be stronger for those who report low levels of peer support, low levels of family support and those who report low levels of parental monitoring. When the analyses investigating the association between IM use and below average well-being were stratified by perceived peer support the estimates of effect sizes were similar across all three groups, particularly for those with low and high levels of perceived peer support. Thus, the evidence does not suggest that associations between IM use and below average well-being differ for those with low compared to medium or high social support in this sample of early adolescents.

The potentially moderating role of perceived social support in associations between social media use and adolescent mental health has been examined, albeit rarely, in the literature. My findings suggest that associations between IM use and mental well-being are similar across all levels of perceived social support and as such do not offer support for either the *rich-get-richer hypothesis* (Kraut et al., 2002) which suggests that online socialisation may be most beneficial to those with high levels of existing peer support and acceptance or to the *social compensation hypothesis* (Campbell et al., 2006) which suggests that online socialisation is more beneficial to those with poor levels of offline peer relationships.

In terms of the role of perceived support from family in longitudinal associations between IM use and adolescent well-being, while the findings in the low family support group suggested that the association between IM use and well-being may be strongest in this group, the confidence intervals estimated across all three family social support strata are very similar. A stronger association among those with low family support who frequently use IM may be indicative of adolescent motivations to use social media to compensate for their low levels of family social support at home but their needs for affiliation and support may not be met online as online communication may not replace

real world communication and provision of social support (Donchi & Moore, 2004; Pea et al., 2012). However, the similar results across all three strata of perceived family support suggested that the association between IM use and below average well-being may not be modified by adolescent perceptions of social support from their family.

The data did not suggest evidence for an association between using IM several times a day (compared to every day or almost daily) and below average mental well-being in the medium-to-high parental monitoring nor the low parental monitoring groups in the stratified analyses. In addition, the estimated effect sizes were similar for both groups. This did not support my hypothesis that mental well-being outcomes related to IM use would be more negative for those with low levels of parental monitoring. It was theorised that adolescents with low levels of parental monitoring would spend excessive time using social media and to use social media more compulsively which was expected to negatively impact their mental health compared to their medium-to-high monitored peers (Yen et al., 2009). The data did not suggest this to be the case in this sample of early adolescents.

Though these stratified analyses have a number of limitations, taking the findings together the evidence did not suggest that the longitudinal association between IM use and adolescent mental well-being was moderated by adolescents' perceptions of social support from their peers, their perceptions of social support from their family, or their levels of parental monitoring.

6.4.2.2 Cyberbullying involvement.

The theorised buffering role of perceived social support in associations between adverse life events and mental health underpinned Hypothesis 7c that the association between involvement in cyberbullying at baseline and poorer mental health at follow-up would be stronger for those with low levels of perceived social support from peers, those with low levels of perceived social support from family support and those who reported low levels of parental monitoring.

Focusing on the role of perceived social support from peers, there was some evidence to suggest cyberbully-victims with high levels of perceived peer support were had increased odds of reporting depressive symptoms at follow-up compared to their peers with low or medium levels of social support at follow-up as the estimated coefficients were largest in this group and were sustained after adjustment for baseline depressive symptoms. The association between being a cybervictim and social anxiety

symptoms was also strongest for those with high levels of perceived peer support. This suggests poorest mental health outcomes for those involved in cyberbullying with high levels of perceived peer support. However, the overlap between the confidence intervals did not provide sufficient evidence to reject the null hypothesis that there were no perceived peer support differences in the associations between cyberbullying involvement and depressive symptoms, social anxiety symptoms, or below-average well-being. High levels of support from peers has been identified as a potential buffer in associations between exposure to a chronic stressor such as bullying and negative mental health outcomes during adolescence (Newman, Holden, & Delville, 2005). However, the results of this study do not suggest that high levels of perceived peer support acted as a buffer to protect adolescents from negative mental health outcomes related to cyberbullying involvement.

Focusing on the role of family factors, both perceived social support from family and parental monitoring have been considered. First, in relation to perceived social support from family, the evidence seems to contradict Hypothesis 7c. There was some evidence to suggest that the association between involvement in cyberbullying as a cyberbully-victim and depressive symptoms at one year follow-up may be strongest among those with high levels of perceived support from family. In addition, the association between involvement in cyberbullying as a cybervictim and social anxiety symptoms at one year follow-up was strongest among those with high levels of perceived support from family. This hypothesis was based on research evidence which had suggested maternal support as a potential buffer against poor mental health outcomes associated with exposure to stressors (Grant et al., 2000). The findings presented in this study, however, tentatively suggest that those with high levels of perceived social support from family may experience the poorest outcomes in terms of mental health in terms of depressive symptoms for cyberbully-victims and social anxiety symptoms for cybervictims.

Second, the associations between cyberbullying involvement and poorer mental health were stronger for those with medium-high levels of parental monitoring though only the association between being a cybervictim and social anxiety were sustained after adjustment for baseline social anxiety symptoms. However, the high levels of overlap between the confidence intervals estimated for those with medium-high and those with low levels of parental monitoring in terms of the effect of baseline cyberbullying involvement on adolescent mental health outcome did not provide sufficient evidence to

suggest a moderating effect of parental monitoring in this association. These findings do not support Hypothesis 7c which may be explained by differences in statistical power between the two strata of parental monitoring, with much lower power in the low parental monitoring group.

While these findings seem somewhat counter-intuitive with poorer outcomes reported for those with high perceived social support from family, Holt and Espelage (2007) found that cybervictims and cyberbully-victims with high (compared to medium) levels of perceived peer support reported highest levels of depression and anxiety while for cyberbullies those with low perceived peer support reported poorest outcomes. However, Holt and Espelage (2007) found that high levels of maternal support were protective against anxiety. Their findings in relation to peer social support were unexpected and they were not directly in line with those presented here. Together, these findings suggest that high levels of perceived social support from family and peers may not play a buffering role of high levels of perceived social support in associations between cyberbullying involvement and adolescent mental health.

There is a large body of research emphasising the mental health benefits of high levels of perceived family support and parental monitoring among adolescents (Rothon et al., 2012; Rothon et al., 2011; Stansfeld, 2005; Viner et al., 2012). It is therefore challenging to present an alternative rationale for these findings as they seem largely counterintuitive. One possible explanation for the findings in the current study, which suggest more negative mental health outcomes for those cybervictims and cyberbully-victims with high levels of perceived family support, is that those participants perceived themselves as less likely to be victimised online and in turn are more negatively impacted by it, reporting poorer mental health at follow-up. This theory was proposed by Perloff (1983) who suggested that individuals who perceive themselves to be least vulnerable to victimisation have the most trouble coping with victimisation if it does occur. Alternatively, research by Riina, Martin, Gardner, and Brooks-Gunn (2013) suggests that racial discrimination leads to more negative mental health outcomes when that discrimination occurs in settings of importance for adolescents (e.g. school), points towards another possible explanation for these findings. It is possible that those with high levels of peer support who report baseline involvement in cyberbullying as a cybervictim or a cyberbully-victim may experience more negative mental health outcomes one year later as these adolescents may place a greater value and importance of their social relationships (and perhaps their online presence) thus, a stressor

experienced in their social world may have a stronger negative impact on their mental health. However, given the exploratory nature of these analyses, these findings need replicating in future studies.

Further investigation of the moderating role of perceived social support using data from a larger cohort may be important to replicate these analyses and statistically test for a moderating effect of perceived family support and parental monitoring in associations between cyberbullying involvement and adolescent mental health (including both internalising and externalising symptoms). Future studies examining the moderating role of perceived peer support in associations between cyberbullying involvement and mental health would be beneficial as perceived social support may represent one possible avenue for intervention.

6.4.2.3 Online communication networks.

Hypothesis 7e was that the association between communicating online with strangers at baseline and poorer mental health at follow-up would be stronger for those with low perceived peer or family support and those who report low parental monitoring. There was little evidence in the data to support this hypothesis.

In terms of perceived social support from peers, there was some evidence to suggest that communication with strangers online is most strongly associated with depressive symptoms among those with medium levels of peer support. However, the overlap between the confidence intervals for those in the low, medium, and high peer support groups does not suggest that the association between online communication with strangers and adolescent mental health is moderated by perceived peer support, refuting Hypothesis 7e. This suggests that social support from peers may not be sufficient to protect cybervictims or cyberbully-victims from poor mental health outcomes. A similar finding was found by Rothon et al. (2011) in their study of adolescent victims of traditional forms of bullying.

Similar results were obtained for analyses exploring the role of family factors in associations between online communication with strangers and adolescent mental health. Focusing on perceived social support from family, online communication with strangers at baseline was neither significantly associated with depressive symptoms, social anxiety symptoms, or well-being at follow-up among those with low, those with medium, or those with high levels of perceived family support. There was insufficient

evidence to suggest a moderating role of perceived family support in associations between communication with strangers online and adolescent mental health.

Those with medium-to-high levels of parental monitoring had increased odds of reporting depressive symptoms at follow-up while the data did not provide evidence for an association among those with low parental monitoring. In addition, the association between communication with strangers online and social anxiety or well-being was neither significant for those with low nor those with medium-to-high levels of parental monitoring. However, the parental monitoring scale was highly skewed and as such had to be collapsed into a binary variable for the imputation. This binary variable was created by comparing the 25% of participants with lowest levels of parental monitoring to the rest of the cohort. Therefore, the stratified analyses for the low parental monitoring group may have low power to detect effects and thus may have been limited in terms of ability to meaningfully differentiate adaptive from maladaptive parental monitoring in adolescents of this age.

Previous research has suggested that communicating online with strangers is more common among adolescents with poor relationships with their parents (Vandoninck et al., 2011) and there was also evidence to suggest that parents may be a vital resource in promoting adolescent resilience against negative outcomes related to adolescent risk taking (Fergus & Zimmerman, 2005). It is plausible that while having higher levels of perceived family support may protect adolescents from engaging in online communication with strangers, family support may not act as a buffer to protect those who communicate with strangers online from negative mental health influences associated with communicating with strangers online. Rothon et al. (2011) reported findings similar to this in relation to traditional bullying. Alternatively, it is also possible that there was not sufficient power in the analyses presented here to detect the smaller effects of family support, given that the stratified analyses did not provide evidence for an association across any of the perceived family social support strata. Future studies may benefit from larger sample sizes to examine the influence of family social support more robustly. In addition, the perceived social support measure focused on social support from family rather than support from parents specifically and it may be that the perceived support of parents, rather than support from siblings or the wider family may be most important and future studies should consider examining specific parent-child relationships more closely.

Taking the exploratory findings together, there was some support for hypothesis 6c as female cyberbully-victims showed stronger associations with social anxiety symptoms at follow-up than male cyberbully-victims. In addition, cyberbully-victims with high levels of perceived social support from family showed stronger associations with depressive symptoms at follow-up than those with low or medium levels of family support. The association between being a cybervictim and reporting social anxiety symptoms at follow-up was stronger among those with high perceived social support from family compared to those with low or medium social support from family. These findings contradicted hypothesis 7c as poorer mental health outcomes were expected for those with low levels of perceived social support from family. There was little unequivocal support for hypotheses 6b, 6e, 7b, or 7e. The role of gender and perceived social support from family may be most salient in associations between cyberbullying involvement and adolescent mental health outcomes.

6.5 Methodological Strengths and Limitations

This study aimed to make a number of methodological contributions to research in this field with a view to strengthening the evidence base relating to the longitudinal associations between the characteristics of social media use and adolescent mental health. A discussion of issues arising during the process of carrying out this research project is included below, along with reflection on factors which may have influenced the strength of the evidence presented in terms of the quality and nature of the findings.

6.5.1 Literature review.

During the course of this PhD, one systematic review has been published focusing specifically on studies of associations between social media use and adolescent mental health and well-being (Best et al., 2014), while another has been published examining existing research on associations between cyberbullying involvement and mental health (Bottino et al., 2015). The papers identified in these reviews reinforced the thoroughness of the literature review conducted for this study as relevant papers had already been identified and included. The literature review has been updated regularly to include more recent papers published since the beginning of this study given the rapid pace at which research on this topic has emerged in recent years.

6.5.2 Study methodology.

6.5.2.1 Study design and response rate.

A key strength of the current study is its longitudinal nature which contributes to the limited existing longitudinal research on this topic. Longitudinal research is needed to explore temporality and lasting mental health effects (Nixon, 2014) and to strengthen the case for a causal mechanism by which discrete features of adolescent social media use might impact mental health. This study has a one year follow-up period and data has been collected at two time points. This advances research in this field considerably as longitudinal findings on this topic are a rarity, however, future research would benefit from more time points to better elucidate causal pathways (Patchin & Hinduja, 2013).

It is important to be aware of the limitations to study generalisability imposed by decisions made in relation to time scales in this study (Zaheer, Albert, & Zaheer, 1999). Zaheer et al. (1999) stresses that the ability to observe change, and the type of change observed depends on the granularity of time scales chosen. For this study, we have looked at current network size, SNS and IM use in the past month, and cyberbullying involvement and communication with strangers over the past 12 months. At each wave, mental health outcomes have been measured with reference to the previous two weeks, and follow-up time was one year. It is important to acknowledge that the use of these time frames may limit the ability to make direct comparisons with studies using different time scales. Greater specification of the timing of exposure-effect relationships in future epidemiological studies with more time points may represent an important next step in determining a causal role for characteristics of social media use (e.g. cyberbullying involvement as a cybervictim or cyberbully-victim) and poorer adolescent mental health outcomes. Longitudinal studies such as this one strengthen the evidence for a causal pathway between characteristics of social media use and adolescent mental health as data from two time points one year apart and the adjustment for baseline mental health reduces the possibility of reverse causality. However, it is impossible to be certain that associations are causal using observational data with just two time points.

The response rate to the study was good with almost 84% of those approached at baseline participating in this study and over 77% of these completing the follow-up questionnaire one year later. This high response rate parallels the baseline response rate of 84% and follow-up response of 75% obtained in the RELACHS study of East London adolescents in 2001 (Stansfeld et al., 2003). The ORiEL cohort has been compared to the most recent census data and the cohort was deemed largely similar with

the caveat that females, Bangladeshi, and White UK adolescents were under-sampled at the first wave of the ORiEL study (Smith et al., 2015). These ethnic discrepancies may be attributable to the self-defined nature of ethnicity in the current study as "mixed" and "other" ethnic groups have been over-sampled in the ORiEL study in comparison to the census data (Smith et al., 2015). Focusing specifically on the longitudinal sample analysed in this study, there was a 23% reduction in being lost to follow-up among females compared to males, while those who reported their ethnicity as Black Caribbean had 59% higher odds of being lost to follow-up compared to their peers who reported their ethnicity as White UK and those who reported receiving free school meals had 32% higher odds of being lost to follow-up compared to their peers who did not receive free school meals. Females were less likely to be lost to follow-up than males though we sampled more males than females at baseline, therefore the longitudinal sample had an even gender balance. Gender, ethnicity and SES variables have been included as covariates in study models.

6.5.2.2 Research setting.

A large-scale survey study in a school-based research setting represented the primary methodology of this study. From a practical and administrative viewpoint, conducting research studies in secondary schools in Britain can be challenging given the high level of curriculum demands on teaching staff which make it understandably difficult to gain access to schools for the purposes of conducting research (Friedman & Orrù, 1991). Friedman and Orrù (1991) emphasise the importance of gaining an understanding of the organisational structure and ethos governing any formal research setting which is of particular relevance when planning to conduct school-based research. Schools taking part in the current study were offered a participation grant of £1000 in acknowledgement of their efforts over the life of the study and to ensure the transactional, collaborative nature of the relationship between the schools and the research teams was established from the outset.

Though there are numerous considerations which need to be made when conducting school-based research, when done properly, its merits outweigh any challenges posed through its use. It is vital that we involve adolescents directly when identifying barriers to achieving physical and mental health among this age group. Conducting research with a passive parental consent procedure, as in the current study, increases the participation of harder to reach participants such as males, individuals

from minority ethnic groups, those with lower grades and those who engage in risky behaviour such as smoking (Testa & Coleman, 2006).

In a longitudinal study such as this, students get the opportunity to be involved in a research study throughout their secondary schooling. Given that this study is situated in areas characterised by deprivation, this may represent one way of getting students interested in the world of academia and giving their local universities a friendly, familiar face in the community. When conducting longitudinal research within the school community the relationship between the researchers and the schools are sustained over time, a style of research which is emphasised by Crosswaite and Curtice (1994) in terms of allowing researchers the opportunity to fulfil their responsibilities and ensure that the findings of the project are disseminated to participants. In my role as research assistant on the ORiEL team, I was responsible for the production of newsletters for the adolescents involved in the study following each wave of data collection to update participants on study progress and preliminary findings. In addition, I have also been involved in updating the study website to keep families and schools involved in the project up-to-date and in keeping in contact with schools regarding publications and study output.

6.5.2.3 Method of assessment.

Beyond the challenges emerging from obtaining access to schools, researchers need to consider the method of assessment and response being used. One key limitation of the current study is that data obtained was all self-reported. Self-report measures are commonly used with adolescents largely because they are efficient and cost-effective (Sawyer, Bradshaw, & O'Brennan, 2008). The reliability of survey measures is important for accurately measuring prevalence of disorders and change in behaviour over time as inaccurate data can lead to errors in policy formulation and evaluation (Rosenbaum, 2009). Self-report measures may suffer from inaccuracy based on adolescents' failure to recall past information or from social desirability effects. Failure to recall previous information can reduce response accuracy but is likely to occur randomly across a population (Crockett, Schulenberg, & Petersen, 1987). To minimise issues with recall, participants in this study recalled mental health information over the past two weeks only using validated measures of specific mental health constructs. Social media items relating to frequency of use refer to the previous month and items relating to more rare behaviours such as cyberbullying involvement and communication with strangers online refer to the previous 12 months but are consistent with the time

frame used for these measures in previous studies (Livingstone & Haddon, 2009; Livingstone et al., 2014; Ybarra et al., 2007).

The second issue with self-report measures is social desirability. Social desirability can pose a greater threat to response validity than recall bias and refers to situations whereby adolescents, rather than responding honestly, respond in a way which makes them look good (Booth-Kewley, Larson, & Miyoshi, 2007). A number of steps have been taken to reduce the likelihood of response bias within the study. For example, participants did not put their names on questionnaires and the researchers emphasise the importance of honesty at the beginning of each study session while also highlighting the confidentiality of responses. Researchers stress that parents and teachers will not see the questionnaires and the presence of the fieldwork team is another way of ensuring the confidentiality of responding (Testa & Coleman, 2006). In addition, large, trained fieldwork teams attend each of the survey sessions to ensure the repeatability of survey conditions and in order to support the students when filling in the questionnaires and to discourage teachers from getting involved during the survey session. This was important for the integrity of the data being collected. However, future studies may benefit from using tablets to administer surveys in school settings which may reduce social desirability effects (Booth-Kewley et al., 2007) and minimise missing data in questionnaires, particularly given that tablets are more affordable and widely available than they were at the time of starting the ORiEL study.

6.5.3 Measures.

Maximising the validity of survey responses is a key consideration when conducting school-based research. Firstly, choosing the most suitable measures and designing the length of the questionnaire so that it is best suited to the age and socio-demographic characteristics of the participants is crucial (Testa & Coleman, 2006). Careful consideration was taken when selecting measures for the current study and the study was piloted with a sample of students and adapted according to pilot outcomes before being administered to the whole cohort. Most measures selected for use in this study were categorical in nature. Though categorical items may reduce sensitivity in comparison to open-ended questions, piloting of the questionnaire emphasised that these types of measures are easier for young adolescents to fill in and a similar approach has been used extensively in other studies of school-aged participants (Livingstone & Haddon, 2009; Livingstone et al., 2014; Stansfeld et al., 2003).

6.5.3.1 Social media characteristics.

6.5.3.1.1 SNS and IM use. A strength of this study is the way in which social media platforms have been explored separately rather than combining all social media use together as has been customary in previous studies. Previous research has highlighted the importance of turning our attention towards looking at the impact of different types of social media on adolescent health and relationships so this approach is supported by the literature (Pollet et al., 2011). The measure of IM and SNS use is restricted to a categorical response which may not have been sufficiently sensitive, particularly at higher levels of use. We allowed participants to indicate that they use IM or SNS several times a day but there may be a good deal of variation in the amount of time spent using either platform among participants in this group. The "several times a day" category may not be sensitive enough as it did not allow for us to discriminate between high and ultra-high level users for whom links with mental health outcomes may differ. Future studies should consider use of a continuous measure of hours and minutes spent using particular social media platforms in a given week in order to be better able to discriminate between levels of use among adolescents. However, researchers should think through the perceived difficulty of such estimations of time required by early adolescent participants filling in such continuous measures. Another limitation is the lack of data on what adolescents are doing while they use SNS or IM. However, it may be difficult to design public health interventions to address social media use at a highly sensitive level of discrete social media activity.

6.5.3.1.2 Cyberbullying involvement.

Broadly speaking, there are three main formats for cyberbullying measures. Some aim to investigate the online sites where the cyberbullying is occurring by asking adolescents whether they have been cyberbullied via email, text, SNS, or IM, for example (Hunt, Peters, & Rapee, 2012). Others investigate the form taken or typography of cyberbullying by asking about specific behaviour including aspects of online harassment or sexual harassment, or aggression (Calvete et al., 2010; Mishna, Cook, Gadalla, Daciuk, & Solomon, 2010). Measures of cyberbullying also differ in the terms and conceptualisation of cyberbullying used. Some studies include a definition of cyberbullying (Hinduja & Patchin, 2008; Kowalski & Limber, 2007), some refer specifically to cyberbullying though allow participants to use their own definition of the term (Li, 2007; Vandoninck et al., 2011) and others refer to specific acts or types of cyberbullying without using the term "cyberbullying" itself (Ybarra et al., 2007).

Previous research has suggested that researchers' and adolescents' definitions of bullying may differ considerably and students rarely include reference to intentionality, power imbalance or repetition in their definitions (Vaillancourt et al., 2008). Therefore, to ensure that the researchers and students were focusing on the same behaviours the latter format of measure was used whereby questions were asked related to specific acts of cyberbullying rather than using the term "cyberbullying" or a definition of cyberbullying. This means that, in the context of this study, "cyberbullying" refers to nasty comments, rumours, and threats sent or received online. Behaviour-based measures of bullying or cyberbullying, such as the measure used in this study, have received more support from researchers as they allow for differentiation of different forms of bullying and victimisation, however, it is not always clear if acts of bullying are being confounded with other forms of aggression (e.g. fighting) (Sawyer et al., 2008). This may be less applicable in an online context, however, given that, as outlined in the literature review, features of repetition, intention, and power imbalance characteristic of traditional bullying may not mirror directly onto cyberbullying. Future studies should consider measurement and definitional issues in relation to cyberbullying in an effort to move towards a consensus in terms of the way in which involvement in cyberbullying among early adolescents should be operationalised.

Cyberbullying of a sexual nature was not addressed specifically in this study, though such forms of cyberbullying may have been included by adolescents within their reports of nasty, aggressive, or rumour-based instances of cyberbullying. However, the prevalence of this was low in the NCGM study (Livingstone et al., 2014) so our statistical power to look at this potentially rare-occurring behaviour may have been limited, particularly given the young age of our participants. In addition, involvement in traditional bullying has not been assessed in the current study but previous research has suggested that cyberbullying involvement may be associated with adolescent mental health over and above the association between traditional bullying and mental health (Bonanno & Hymel, 2013).

Sensitivity analyses were performed which adjusted longitudinal cyberbullying analyses for whether the participant reported that they were "ever bullied" using a single item from the negative life events questionnaire used in the ORiEL study. The limitations of this single item measure have already been discussed. In an attempt to adjust for the confounding effects of traditional bullying these sensitivity analyses were carried out and the results suggested that after adjusting for "ever bullied" and baseline

mental health association between involvement in cyberbullying and mental health were sustained for cyberbully-victims but not for cybervictims. Given differences between cyberbullying and traditional forms of bullying, however, particularly with reference to the way to which characteristics of traditional bullying (repetition, power imbalance, and intention) map onto the online context of cyberbullying, the extent to which adjustment for traditional forms of bullying should be carried out should be considered.

6.5.3.1.3 Online network characteristics.

One limitation of the measure of adolescents' online network size is that it is not possible to tell from this data exactly who these online contacts are and whether those communicated with online are the same age as the study participants, whether they are real-life friends and friends-of-friends, family members, or complete strangers. Future studies may benefit from an examination of the extent to which mental health outcomes are associated with the specific people with whom adolescents communicate with online and the characteristics of those relationships.

6.5.3.2 Mental health characteristics.

The use of standardised, validated measures of mental health is a key strength of this study. This study expands on previous research by measuring mental health across multiple domains including depressive symptoms, social anxiety symptoms, and mental well-being. The measures of symptoms of depression and social anxiety have both been shown to discriminate between clinically referred psychiatric adolescents and unselected adolescents (Angold et al., 1995; Ranta et al., 2012). However, it is important to point out that those above the cut-off score for depression and social anxiety are not necessarily clinically depressed or socially anxious; these participants simply report symptoms of depression and/or social anxiety. In terms of the mental health characteristics of the sample, the proportion of participants reporting depressive symptoms at follow-up (24.8%, aged 13-14) is comparable to the findings of the RELACHS study (25.0% for 13-14 year olds) (Stansfeld et al., 2003) of adolescents in East London in 2001, which also used the SMFQ study to measure depressive symptoms.

This study is also strengthened by the measurement of symptoms of mental illness alongside the measurement of mental well-being, an approach which supports the two-continua model of mental health. However, future research should further examine the stability and change in mental well-being over time in early adolescents as the stability in mental well-being scores measured throughout the course of the ORiEL

study raises some questions as to the extent to which well-being may be considered more of a trait than a state among this population (Ormel, 1983). Future studies would also benefit from an examination of externalising behaviours (e.g. conduct disorder, substance misuse, and truancy), particularly as these behaviours may be more strongly linked with perpetration of cyberbullying (Fletcher et al., 2014).

6.5.4 Strength of evidence

6.5.4.1 Adjustment for individual characteristics

To date, little is known about which personal characteristics might be important in associations between the characteristics of social media use and adolescent mental health. As a result, few studies adjust for individual characteristics in analyses (Patchin & Hinduja, 2013). Using a psychiatric epidemiological approach, the multivariable logistic regression models carried out in this study have been adjusted for three individual characteristics identified as potential confounding factors – gender, ethnicity, and socioeconomic status. Adjustment for gender seemed to have the greatest impact on results and gender was associated with mental health outcomes across all models.

Participants were asked to self-define their ethnicity for the purposes of this study using a census-based question adapted for use in this population of adolescents. From experience in the classroom during fieldwork, it was apparent that this was a difficult question for participants to answer in this highly multi-ethnic cohort. The 24 ethnic groups presented to participants, adapted from the 2011 Census, aimed to cover the main ethnic groups in this cohort, though it was necessary to collapse this variable down to an 11 category variable representing the most frequently selected groups for analytic purposes. A key strength of this study is its multi-ethnic nature, given that the majority of studies to date have been based on predominantly White European or White American participants (Bannink et al., 2014; Valkenburg & Peter, 2007b) or on studies in which ethnicity information has not been included (Apaolaza et al., 2013; Gamez-Guadix et al., 2013). However, from an analytic viewpoint the ethnic diversity is also a limitation as it is difficult to make any inferences based on the diverse "other" categories presented. Bulmer (1996) argued that members of an ethnic group have a real or imagined shared past, are held together by a common cultural focus (e.g. on a particular religion or territory) and are aware of their membership of the group. These "other" groups are made up primarily of participants who report dual ethnic identities and are quite heterogeneous groups within this study. In this sense, collectively, those

who report their ethnicity as "other" may share none of these defining characteristics of an ethnic group (Gardener & Connolly, 2005).

In terms of socioeconomic status, it is important to note that the ORiEL study has focused specifically on a cohort of adolescents living in four East London boroughs characterised by high levels of deprivation. As such there may be a uniformity of deprivation among this sample of adolescents which is not directly comparable to the population of adolescents living across the rest of the UK. In addition, the internal consistency of the FAS II, measuring socioeconomic status, as assessed using Cronbach's alpha was very poor. While an additional measure of free school meals status has been included it is possible that analyses remain under-adjusted for SES. Many adolescents find it difficult to report their parents' occupations, education levels, and income and indices of material affluence such as the FAS II have been included in survey data in the past (Currie et al., 1997) as an alternate objective measure of family affluence. The FAS II includes four items relating to family car ownership, family holidays, household computer ownership, and whether the participant has their own bedroom. However, in recent years the price of computers has dropped relative to average household income which has increased ownership of a personal computer, laptop, or tablet (Luu & Freeman, 2011). In addition, owning a car or van is less common in London than other parts of the UK (Aldred & Jungnickel, 2014), perhaps as car ownership may be seen as non-essential in London given the extensive public transport network and thus may not reflect material deprivation either. In conclusion, it is plausible that the items of the FAS II have become outdated in their suitability for assessing family affluence among adolescents in East London which may offer an explanation as to why the internal consistency of the items on this measure showed such poor internal consistency. Future studies should be highly cautious of using the FAS II in cohorts similar to this and be mindful of the potentially brief shelf-life of particular indices of material deprivation when using such measures in longitudinal research.

While the adjustment for individual characteristics including gender, ethnicity, and SES is important, there are other individual factors potentially confounding associations between social media characteristics and adolescent mental health. Most notably, during this critical period of early adolescence, pubertal status may impact both adolescent social relationships and adolescent mental health. In terms of social relationships, the development of social cognitive skills during adolescents, including perspective taking and empathy, parallels adolescent pubertal development and the

development of these biological and psychosocial factors may be interdependent during this critical life stage of adolescence (Blakemore, 2012). There is also a growing body of evidence which points towards the link between puberty and the onset of psychological distress and mental illness, particularly in girls (Angold, Costello, & Worthman, 1998; Maughan, Collishaw, & Stringaris, 2013). Research evidence also suggests that this may be particularly the case for those who experience early onset puberty, particularly in terms of breast development (Joinson, Heron, Lewis, Croudace, & Araya, 2011). The association between puberty and onset of symptoms of mental illness may be driven by hormonal and physiological changes occurring in the adolescent body but may also be related to the psychosocial experience of puberty as early onset of puberty may be associated with negative emotions including shame, fear, worry, and feelings of being different from others in the peer group (Short & Rosenthal, 2008).

Other potential confounders which may be particularly important given their links to adolescent mental health outcomes include adolescents' experiences of early life adversity (Clark, Caldwell, Power, & Stansfeld, 2010), family history of mental illness (Thapar, Collishaw, Pine, & Thapar, 2012), and early life factors including low birthweight (Colman, Ploubidis, Wadsworth, Jones, & Croudace, 2007). Adjustment for gender, ethnicity, and SES is a strength of this study but future cohort studies should aim to adjust for individual characteristics as much as possible to better identify the independent associations between social media characteristics and adolescent mental health. However, it is challenging to obtain reliable data on pubertal status, family history of mental illness and adversity, and early life factors such as birthweight in a self-report school-based study of early adolescents.

6.5.4.2 Causal evidence

Though it is not possible to prove an association is causal there are certain characteristics of an association which are considered to strengthen the evidence for an association being causal. Hill (1965) identified a checklist of some of these characteristics which should be considered when interpreting evidence for a causal association. A strong association is considered more likely to be causal than a modest one. The associations reported in the current study are quite strong and are sustained even after adjusting for individual characteristics. Most previous studies have not reported on the strength of association and so these results offer stronger evidence

related to the association between characteristics of social media use and adolescent mental health.

Hill (1965) also emphasised the importance of consistency in results. The results of this study are also consistent with the limited existing research in the field. The study also meets Hill's (1965) criterion of temporality as the exposure variables were measured at baseline and the outcome was measured one year later with models adjusted for baseline mental health. The findings are plausible in terms of current theory, another causal criterion, and are coherent with findings of other researchers in the field. While this checklist is not exhaustive, the current study extends research in this field by meeting several of the criteria identified by Hill (1965).

6.5.5 Analytic approach.

6.5.5.1 Epidemiological approach.

The epidemiological approach taken in this study strengthens the applicability of the findings as a risk factor approach is consistent with the focus of current public health research on mental health. Rather than being spread evenly across the population, mental health disorders have been shown to be heavily patterned in terms of genetic factors, individual factors (age, gender, ethnicity), and environmental factors (e.g. education, socioeconomic status, experiences of adversity, and traumatic life events). However, the relative impact of many of these risk factors remains unknown (Kirkbride, 2015). In 2007, approximately one in four (23%) adults in the UK met the criteria for at least one of the psychiatric conditions examined in the Adult Psychiatric Morbidity Study (Weich, Hussey, Pickup, Purdon, & McManus, 2009) and given the heavy social patterning of these disorders, epidemiological studies examining social and individual factors predictive of mental disorder and to identify groups in which prevention is likely to be most successful are crucial (Smits et al., 2008).

Epidemiological data is a valuable resource to mental health service commissioners who have to make decisions about the efficient and effective allocation of increasingly finite resources for mental health disorders throughout the population (Kirkbride, 2015). Kirkbride (2015) argues that a three-pronged approach is needed to assess and treat mental health problems. First, empirical epidemiological studies are essential to provide robust evidence as to the epidemiological characteristics of any mental health disorder and to identify how that risk varies across the population. Second, the effectiveness of services and treatments needs to be demonstrated before

interventions are rolled out and third, it is critical that we have a precise understanding of local population characteristics to understand how epidemiological risk translates into public health impact of different disorders. This understanding of local need is central to a move towards integrated and evidence-based public health, particularly as less than one-quarter of those with mental health disorders (not including psychosis) are receiving any treatment. Epidemiological approaches to research will provide a greater evidence base to inform commissioners so that resources can be focused on local need and thus allocated more effectively across populations in terms of preventing mental ill-health. This study goes some way towards addressing the first and third of the aforementioned recommendations made by Kirkbride (2015). It provides empirical data as to the likelihood of reporting depressive symptoms, social anxiety symptoms, and below average mental well-being depending on adolescents' social media usage characteristics in a largely representative sample of adolescents in the localised, multi-ethnic population of East London. In addition, findings of this study suggest that interventions designed to target cyberbullying involvement and communication with strangers online may be effective in reducing mental ill-health among adolescents, and in turn improve mental health outcomes in later life.

6.5.5.2 Analysis.

The design of this study facilitated both cross-sectional and longitudinal analysis of this community-based sample of adolescents in East London. While the data were longitudinal, with only two time points it was not possible to explore change in pathways between characteristics of social media use and adolescent mental health over time. While adjustment for baseline mental health aims to illustrate that mental health outcomes are independent of baseline mental health, given that current mental health scores (in terms of depression, social anxiety, and well-being) are related, it is possible that adjusting for baseline mental health in longitudinal analyses may have been an over-adjustment. Throughout this study, analyses were reported in terms of odds ratios or relative risk ratios with 95% confidence intervals, and accompanying p-values, and were deemed "statistically significant" where $p<0.05$. This cut-off is used widely in the empirical literature though it is essentially arbitrary (Sterne & Smith, 2001). Throughout the thesis I have emphasised findings which should be interpreted cautiously due to wide confidence intervals or reduced power (such as the exploratory analyses relating to the role of gender, peer support, and family factors). For the main analyses, effects considered of borderline significance ($p<0.06$) were also identified and discussed.

It is also important to acknowledge that the analytic approach used may have influenced findings. On one hand, the sample size may not have been large enough to detect smaller effects and thus there may have been some Type II errors. On the other hand, I have not corrected for multiple testing (e.g. Bonferroni correction) and so this may have increased the Type I error rate leading to false identification of differences between groups. Streiner and Norman (2011) suggest that Bonferroni corrections may not be necessary if a small number of hypotheses have been stated a priori, as is the case in this study, or where analyses are exploratory as is the case for analyses relating to the role of gender, peer support, or family factors. Interpretation of the strength of evidence is relative to the models tested within this thesis and it is possible that further multivariable analysis including a different set of confounding factors may have altered the results.

The use of multiple imputation to address missing data was a key strength of the current project. One of the drawbacks of self-report school-based data collection is the tendency toward missing data (up to 35% on certain variables in this study). Missing data was largely attributable to variation in English literacy and comprehension levels among adolescents and to variation in session length and became less common as the adolescents got older. Failure to address this missing data may lead to biases in analyses (White et al., 2011). This has been addressed using multiple imputation methods in the current study – a method advised for use in social research (Brunton-Smith et al., 2012). While the REALCOM software allowed for imputation at two levels (participants at Level 1 and wave at Level 2) to account for the repeated measures used in this study (Carpenter et al., 2011), it was not possible to include a third level (for school) in REALCOM which meant that school had to be included in analyses as a fixed rather than a random effect which may have inflated the Type I error rate. Comparisons between the analyses carried out using the imputed data and those carried out on the complete record data suggested the findings were largely similar.

This study builds upon previous research by adjusting analyses for gender, ethnicity, socioeconomic status, and school. Future studies should adjust for these factors to avoid over- or under-estimating associations between social media use and adolescent mental health. Also, future studies aiming to examine moderation analyses should bear in mind the methodological challenges in conducting such a study in an adolescent cohort; it is likely that larger sample sizes than were available in this study would make such analyses more robust.

6.6 Study Implications

This study provides local data, the first in the UK, on a cohort of early adolescents living in areas of East London characterised by high levels of deprivation. The findings of this study are particularly relevant in terms of their public health implications. In addition, the findings of this study raise a number of recommendations for future research and possible interventions.

6.6.1 Public health implications

This study adds to our understanding of adolescent mental health by suggesting that cyberbullying involvement represents a new phenomenon which may be exacerbating adolescent mental health problems. While traditional bullying has been identified as an important modifiable risk factor for mental illness (Scott, Moore, Sly, & Norman, 2014b) addressing the new phenomenon of cyberbullying is vital if successful interventions are to be implemented (Kozlowska & Durheim, 2014b). The finding that cybervictims and cyberbully-victims report poorer mental health at one year follow-up compared to their uninvolved peers emphasises the importance of designing, implementing, and evaluating anti-cyberbullying programmes in adolescents' schools and in their other social environments. Bullying prevention programs should be viewed as important environmental and public health interventions (Reed et al., 2015).

Current NICE guidelines emphasise the need for secondary schools to promote comprehensive, school-wide approaches to addressing adolescents' social and emotional well-being (NICE, 2009). This study emphasises that the characteristics of adolescents' social media use may play an important role in shaping adolescent mental health outcomes. As such, school approaches to promoting well-being need to take adolescents online experiences into account, even though online experiences may extend beyond the school gates. In addition, NICE guidelines emphasise that schools need to foster an ethos which promotes mutual respect, and successful relationships (NICE, 2009). Given the strong links between social relationships and mental health (Cohen et al., 2000; Stansfeld, 2005) and based on the findings of this study, it is important that adolescents are motivated and equipped with the necessary social and emotional skills to extend a similarly positive ethos of mutual respect and successful relationships into their online environments.

Findings of this study suggest that high frequency IM use, involvement in cyberbullying as a cybervictim or cyberbully-victim, and communication online with

strangers are all associated with increased odds of reporting depressive symptoms and social anxiety symptoms and increased risk of reporting below average well-being at follow-up compared to regular IM users, those uninvolved in cyberbullying, and those who do not communicate with strangers. In light of these findings, pastoral care services in schools should be aware that adolescents' socioemotional issues may be linked to their social media activity and as such should discuss the extent to which students' emotional, social, or behavioural problems are driven by or exacerbated due to experiences related to social media. This is particularly important given the permanence of online messaging and the associations between certain characteristics of social media use and adolescent mental health one year later observed in this study. Clinicians should also be mindful of associations between IM use, cyberbullying involvement, and online communication with strangers, and mental health outcomes when addressing adolescent mental health concerns, though additional research is needed to extrapolate the causal pathways involved in these associations. Notably, findings of this study suggested that students involved in cyberbullying were most commonly involved as both targets and perpetrators of cyberbullying (cyberbully-victims) and clinicians, pastoral care workers in schools, teachers, and parents, should be aware of this. The development of adolescents' social and emotional skills should be promoted in all areas of the secondary school curriculum according to guidelines by NICE (2009). Based on the findings of this study, it is recommended that programmes to develop adolescents' social and emotional skills (e.g. empathy) should be tailored to the changing needs of early adolescents as they connect with peers via social media which may place different demands on their social and emotional skills compared to face-to-face communication.

Given that approximately 40% of the sample in this study reported some involvement in cyberbullying when surveyed in Year 8, these findings highlight that cyberbullying is a problem which is highly prevalent among early adolescents and as such, those working with students in Year 8 or younger should be made aware of the features of cyberbullying and its negative associations with adolescent mental health. Indeed, cyberbullying awareness and prevention efforts should target younger children, as rates of involvement are high by the time early adolescents reach 12-13 years of age and cyberbullying prevention efforts may be helpful before rates of cyberbullying increase to these high levels.

This study yielded a number of unexpected findings which may also have public health implications. First, this study did not provide evidence to suggest an association

between frequency of SNS use at baseline and mental health outcomes at follow-up and high frequency of IM use was associated with below average well-being but not symptoms of mental illness. It is therefore possible that public health interventions focusing on frequency of social media use by adolescents may be less effective, in terms of improving mental health, than interventions which focus on the specific communication activities adolescents engage in online. These specific online communication activities may include the extent to which adolescents are involved in negative interactions or conflict online (e.g. cyberbullying) and on the sorts of relationships adolescents nurture in an online context (e.g. communication with strangers). However, it should also be noted that, contrary to study expectations, this study did not provide evidence to suggest that non-use of social media was associated with poorer mental health outcomes among early adolescents. Public health recommendations which support parents in decision-making related to the age at which young people are allowed to use social media should aim to allay parental fears related to poorer mental health outcomes for early adolescents who do not use social media as the findings of this study do not suggest that this is the case.

As social media use transcends school and home boundaries, schools and parents need to work together and in collaboration with young people to ensure that adolescents do not experience negative mental health outcomes related to their social media use. Schools should support parents to better understand the way in which adolescents use social media and the potential negative mental health outcomes associated with their use. Issues surrounding the responsibility of schools in dealing with problems arising from off-site social media use by students are complex (Willard, 2007). However, school staff members are an authority on dealing with interpersonal relationships among adolescent peers. Schools are already encouraged to give families the support they need to fully participate in activities to promote adolescent social and emotional well-being (NICE, 2009) and in light of the findings of this study, this should extend explicitly to school-based support for parents dealing with social, emotional, and behavioural issues related to adolescents' social media use, even when social media use is occurring away from school grounds.

Interventions to improve adolescent mental health should focus both on reducing or eliminating risk factors and on increasing adolescents' resources and exposure to protective factors (Schoon, 2006, p. 160). Schoon (2006, p. 162) emphasises that interventions should be designed with an awareness of the context in which adolescent

behaviour occurs and should not target skills in isolation. Adolescents do not use social media in a vacuum and their online and offline behaviour is likely to interact. As such, improving adolescents' social skills may represent an intervention that would have public health benefits in terms of adolescents' online and offline behaviour. Interventions to improve adolescents' social skills development may promote adolescent resilience as enhanced social skills may enable adolescents to show more adaptive responses to cybervictimisation or other interpersonal adversities which may have a positive influence on adolescent mental health. In terms of cyberbullying, the finding that cyberbullies did not experience poorer mental health outcomes compared to those uninvolved in cyberbullying was unexpected. Future studies may benefit from examining empathy given that previous research has suggested that cyberbullies may be less empathic than non-cyberbullies (Brewer & Kerslake, 2015; Steffgen, König, Pfetsch, & Melzer, 2011). Teaching social skills, including empathy, may be one useful intervention to lower rates of cyberbullying involvement and the permanence of online messages. Previous research has suggested that offering a social skills training intervention may reduce prevalence of bullying among adolescents (Lovegrove & Rumsey, 2005) and as such, social skills training to include teaching empathy may represent an effective intervention to reduce cyberbullying prevalence among early adolescents. In addition, a restorative justice approach (Karp & Breslin, 2001) to address the harm caused by cyberbullying experiences may increase adolescents empathy by facilitating face-to-face discussions around the emotional underpinnings and psychological impact of messages sent and received online. As such, a restorative justice approach may represent another possible method of intervention to address the harm caused by cyberbullying.

It was anticipated that those with larger online networks would report better mental health outcomes as large networks would be representative of available social support. The findings of this study did not support this hypothesis and the findings also suggested negative outcomes related to communication with strangers, as expected. Public health recommendations should encourage parents to monitor their child's online communication and actively discourage communication with strangers online as the focus on weak-tie relationships in an online context may exacerbate problems related to online disinhibition.

School programmes which teach young adolescents online etiquette should be considered. Given that social cues are impaired behind the screen compared to face-to-

face communication (Suler, 2004), adolescents may need explicit teaching relating to how to approach online communication. Adolescents should be taught about developing trust and intimacy in peer relationships and how to respect others' trust and intimacy in an online environment. In addition, adolescents should be taught about their online behaviour and how it may have a negative impact on others. Perhaps interventions which promote and enhance aspects of perceived partner responsiveness including intimacy, trust, acceptance, and empathy in an online domain may be most effective in terms of reducing associations between characteristics of adolescent social media use and poorer mental health outcomes.

In the introductory chapter, the importance of social relationships in influencing adolescent mental health was discussed with particular reference to previous discussion of this topic by Cohen et al. (2000) and Stansfeld (2005). A psychiatric epidemiological approach was deemed appropriate in terms of identifying risk and protective factors for adolescent mental health, and in turn mental health throughout adulthood. From a public health research perspective, it is important to be able to estimate the size of effect a particular exposure (characteristics of social media in this case) may have on mental health outcomes and also to be able to illustrate the extent to which associations observed are independent of confounding factors which have an established link to mental health. Public mental health interventions may be most pertinent for those factors which have a large effect on mental health even after accounting for other important variables known to be associated with mental health (e.g. gender). While it is not possible to infer causality from observational studies such as this one, the adjustment for individual factors strengthens the argument for a causal link between IM use, cyberbullying involvement, and communication with strangers, and adolescent mental health.

6.6.2 Future research

As this cohort of adolescents live in East London, the extent to which these adolescents are representative of adolescents across the whole of the UK is unknown. The findings of this study are particularly relevant in the context of East London and future studies should examine the extent to which these findings generalise across a wider UK context.

Recommendations for future research in relation to each of the social media characteristics have been outlined in previous sections of this discussion. To summarise, these included recommendation for future studies to:

i) Focus on extent to which adolescents use SNS and IM passively or actively and the intrusiveness of their specific online activities
ii) Continue to classify student involvement in cyberbullying in terms of whether they are targets (cybervictims), perpetrators (cyberbullies), or both targets and perpetrators (cyberbully-victims) of cyberbullying to elucidate mental health factors associated with each type of involvement, particularly, as intervention efforts may also impact each of the three involvement categories differently
iii) Examine the extent to which there is a dose-response relationship between cyberbullying and mental ill-health by examining whether more frequent cyberbullying involvement is associated with poorer mental health outcomes than cyberbullying which occurs less often.
iv) Study the features of online communication with strangers in terms of the identity and age of those strangers and the adolescents' underlying motivations and more objective measures of network size would be preferable to relying on self-report items.

Recommendations have also been made relating to mental health outcome measurement. It was suggested that future studies should:

i) Examine multiple mental health outcomes
ii) Examine externalising outcomes, particularly in relation to involvement in cyberbullying as cyberbullies and cyberbully-victims may be more likely than their uninvolved peers to report externalising symptoms (e.g. conduct disorder, alcohol and drug misuse, truancy).
iii) Acknowledge that mental health findings are limited to the outcomes specifically tested as findings may not generalise to other mental health outcomes (Schilling et al., 2007).

Future studies may also benefit from some of the methodological findings emerging from this study. It is recommended that future studies are carried out to:

i) Replicate these findings, determine their generalisability to older groups of adolescents, or to adolescents living in less urban, less ethnically diverse, or less deprived areas in the UK.
ii) Add to the longitudinal research on this topic. This is critical in this field and studies should aim to conduct prospective studies with as many time points

as possible to strengthen the case for a causal mechanism by which social media use impacts future adolescent mental health.

iii) Look more broadly at adolescent social media use and pull together research from these often disparate fields with a view to answering interdisciplinary questions relating to the impact of social media use on adolescent mental health

6.7 Conclusions

Understanding risk factors for adolescent mental health is critical as the foundations for future mental health problems are laid during adolescence (Sawyer et al., 2012). This study asked the question: how is the mental health of adolescents impacted by the characteristics of their social media use? Based on the findings presented here, the answer to this question is threefold. First, the findings of this study suggest that it is important to consider multiple characteristics of adolescent social media use. Poorer mental health outcomes at one-year follow-up were reported by those who used IM several times a day compared to those who used IM daily or almost daily; by those who reported being cybervictims or cyberbully-victims compared to their uninvolved peers; and by those who reported communicating online with strangers compared to those who did not communicate with strangers. This suggests that adolescent mental health at one-year follow-up may be negatively impacted by the characteristics of their social media use at baseline, though further research is needed to strengthen the evidence for a causal mechanism by which these associations occur.

Second, the exploration of multiple mental health outcomes suggests that there may be some specificity in the mental health effects of social media use. Associations between IM use and mental health were only observed for well-being and not for symptoms of depression or social anxiety, for example. It is important that future studies continue conceptualise mental health in terms of multiple constructs, particularly symptoms of depression and social anxiety, and mental well-being as this study demonstrated associations between characteristics of social media use and each of these mental health domains. Finally, analyses have explored prospective associations between the characteristics of adolescent social media use and mental health outcomes at one year follow-up. As such, the longitudinal findings reported suggest that characteristics of social media use may have sustained associations with adolescent mental health over a one year period. Future studies are needed to further examine

temporality in associations between characteristics of social media use and adolescent mental health.

This study emphasises the relevance of research in this field to parents, educators, clinicians, and public health workers interested in adolescent mental health in a UK setting. The psychiatric epidemiological approach used in this study should be considered in future studies. Many previous studies have failed to take individual factors (e.g. gender) into account and have not provided any estimates of effect sizes in terms of associations reported between social media use and adolescent mental health. Inconsistent findings reported in existing empirical research on this topic may be attributable to the lack of adjustment for individual factors or to potentially small or negligible effect sizes which are being reported as significant. From a public health perspective, it is important that the magnitude of effect is reported in future research, particularly if the need for intervention is to be determined and the evidence basis for successful interventions is to be robustly evaluated.

In conclusion, the findings of this study suggest that social media may represent a setting in which interpersonal stressors may manifest. Characteristics of social media use among adolescents are related to their mental health one year later. These characteristics of social media use are reported by a large proportion of adolescents, and are associated with a negative influence on adolescent mental health which should not be ignored. Cyberbullying rates were high among early adolescents in this sample and those involved in cyberbullying as cybervictims or cyberbully-victims had increased odds of reporting symptoms of depression and social anxiety at follow-up than their uninvolved peers. In addition, cyberbully-victims emerged as the most prevalent groups. While overall frequency of SNS use was not associated with mental health outcomes in this study, those who used IM several times a day had an increased risk of reporting below average well-being at follow-up compared to their peers who used IM daily or almost daily to report below average well-being. Finally, communication with strangers, reported by over a quarter of the 12-13 year old sample at baseline, was associated with poorer mental health outcomes at follow-up in this study. Overall, it is recommended that public health interventions aimed at improving adolescents' mental health may be effective if designed to intervene on aspects of their responsiveness to their peers in an online context. It is proposed that such interventions should be focused on enhancing adolescents' empathy, intimacy, and interpersonal trust online and on building adolescent resilience.

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8 APPENDICES

8.1 Appendix 1: Head Teacher Information Letter and Consent Form

Evaluating the impact of urban regeneration on young people and their families

Information for the School

We would like to invite your school to take part in this research project. You should only agree for the school to take part if you want to - it is entirely up to you. If you choose not to take part there won't be any disadvantages for you or your school and you will hear no more about it.

Please read the following information carefully before you decide to take part; this will tell you why the research is being done and what your school will be asked to do if you take part. Please ask if there is anything that is not clear or if you would like more information. If you would like to take part you will be asked to sign a consent form to say that your school agrees. You are still free to withdraw at any time and without giving a reason.

The 'Evaluating the impact of urban regeneration on young people and their families' study is funded by the National Institute of Health Research to examine how changes to the local area, as a result of the Olympic Games in East London, impact on young people's and their families' health and well-being. We are interested in how these changes impact on your pupils' day-to-day life. The results of this research will provide information to guide future redevelopment schemes in the UK in terms of what aspects of urban redevelopment promote health and well-being.

This research is being conducted by researchers based at Queen Mary, University of London, the London School of Hygiene & Tropical Medicine and the University of East London.

If you choose to participate:

1. Young people in year 7 will be asked to complete a questionnaire during one class about their health, health behaviours and attitudes.
2. They will also have their height and weight measured, in private.
3. We will also want to follow-up these young peoples' health and attitudes by asking them to complete questionnaires on two further occasions over the next four years.
4. This study will be strengthened by collecting additional data from the young peoples' parents. We would therefore like the school to assist us in contacting parents, in the first instance.

All questionnaire responses will be kept **completely confidential** by the research team. No names will be on the questionnaires and no school will be identifiable in the analyses. The researchers will additionally look at school and neighbourhood data so they can find out more about the participants without collecting data from them.

If you are willing for the school to participate in this study, we would be able to donate £1000 to the school.

It is up to you to decide whether or not to take part. If you are concerned with any aspect of the research, please contact Neil Smith (n.r.smith@qmul.ac.uk or 020 7882 2039) or Charlotte Clark (c.clark@qmul.ac.uk or 020 7882 2017) who will be able to answer any questions.

School Consent Form

Please complete this form after you have read the Information Sheet and listened to an explanation about the research.

Title of Study: "Evaluating the impact of urban regeneration on young people and their families"

Queen Mary Research Ethics Committee Ref: QMREC2011/40

- Thank you for considering taking part in this research. The person organizing the research will have explained the project to you before you agree to take part.
- If you have any questions arising from the Information Sheet or explanation already given to you, please ask the researcher before you decide whether to join in. You will be given a copy of this Consent Form to keep and refer to at any time.
- *I understand that if the school no longer wishes to participate in this research, the school can notify the researchers involved and be withdrawn from it immediately.*
- *The school consents to the use of information collected for the purposes of this research study. I understand that such information will be treated as strictly confidential and handled in accordance with the provisions of the Data Protection Act 1998.*

Participant's Statement:

I _____ of _____school agree that the research project named above has been explained to me to my satisfaction and I allow the school to take part in the study. I have read both the notes written above and the Information Sheet about the project, and understand what the research study involves.

Signed: Date:

Investigator's Statement:

I _____ confirm that I have carefully explained the nature, demands and any foreseeable risks (where applicable) of the proposed research to the volunteer

8.2 Appendix 2: Parent Information Letter and Opt-out Consent Form

Evaluating the impact of urban regeneration on young people and their families

Letter for parents/carers

The Principal has permitted us to undertake a research study in your child's school – Langdon Park. The study is examining the impact of community changes associated with the 2012 Olympic Games in East London on young people's and their families' health and well-being. We are interested in how the changes in your neighbourhood impact on your families' day-to-day life. Over 3000 adolescents in East London will take part in the study. Please read the following information carefully as this will tell you why the research is being done and what your child will be asked to do if they take part.

The purpose of this study is to examine the impact of community changes associated with the 2012 Olympic Games in East London on young people's and their families' health and well-being. We are interested in how the changes in your neighbourhood impact on your day-to-day life. The output from this research will provide information for future redevelopment schemes in the UK in terms of what aspects of urban redevelopment promote health and well-being.

If your child chooses to participate they will be asked to complete a questionnaire about their health, health behaviours, and attitudes in a classroom with their classmates during class time. They will also have their height and weight measured in private to assess their physical growth. There is also a possibility that we may contact your child in a few years to follow-up on their health and attitudes. All questionnaire responses will be kept completely confidential by the research team. Your child's name will not be on the questionnaire. The researchers will additionally look at neighbourhood data so they can find out more about your local area without asking you.

You are free to choose whether your child participates in the study. Your child will also be asked to decide if they wish to be part of this research project, when we visit the school. If you decide that your child should not take part there won't be any disadvantages for you or your child and you will hear no more about it.

If you do not want your child to take part in the study please sign the form on the other side of this page and return it to the school in the next two days.

We also hope to involve as many parents as possible in the study and someone will contact you in the next few weeks about this study. Any involvement is voluntary.

If you are concerned with any aspect of the research or if you would like more information, please contact Neil Smith (n.r.smith@qmul.ac.uk or 020 7882 2039) or Charlotte Clark (c.clark@qmul.ac.uk or 020 7882 2017) who will be able to answer any questions.

Evaluating the impact of urban regeneration on young people and their families

Parent's Opt -out Form

Only fill in this form if you do **NOT want your child to take part.**

I do NOT want my child _____ *(insert child's name)* **to** take part in the 'Evaluating the impact of urban regeneration on young people and their families' being carried out by Queen Mary, University of London. I have read the information sheet. I know what is required of my child to participate in this study and I do NOT want him/her to participate.

Signed _____

Name in Block Letters _____

Child's Name in Block Letters _____

Date _____

8.3 Appendix 3: Pupil Information Letter and Assent Form

Evaluating the impact of urban regeneration on young people and their families

Who are we?

We are researchers who look at lots of different pieces of information about people's lives so that we can try and improve people's health. We work at a number of different universities in London: Queen Mary, University of London, the London School of Hygiene & Tropical Medicine and the University of East London.

What are we doing?

We are working on a project which is investigating how the changes in your local area, because of the Olympic Games, have affected you, your day to day your life, and you and your family's health. The project is called "Evaluating the impact of urban regeneration on young people and their families" and the money for this project is given by the National Institute of Health Research.

Why are we doing this?

Many areas in Britain are changing and we need to know the best way to help areas improve so that people's health also improves.

How can you help us?

We need your help so that we can see how these changes in your local area have affected young people's health in East London. There are 2 ways that we will need you to help us:

5. You will be asked to complete a questionnaire during class time about your health and day to day life. We will visit you again, at school, in year 8 and year 9 to get your views.
6. You will have your height and weight measured. This will be done in private and no one will know this information. The only people who will know this information will be the researchers and they will not be allowed to tell your parents, teachers or classmates.

Your answers on the questionnaire and height and weight will be kept **completely confidential** by the research team. Your parents and teachers will not be able to see your answers and your name will not be on the questionnaire. The researchers will also be looking at information from the local neighbourhood so they can find out more about your local area without collecting information from you.

We hope that you have read the information above carefully. If there is anything you don't understand, are concerned about or if you have any questions you would like to ask then please make sure you ask us today or contact Neil Smith (n.r.smith@qmul.ac.uk or 020 7882 2039) or Charlotte Clark (c.clark@qmul.ac.uk or 020 7882 2017) who will be able to answer any questions.

What do you need to do now?

Decide if you want to take part in our project. If you do not want to take part then you will not have to explain your reasons. You are also able to change your mind and stop taking part later on. However if you do wish to take part in our project then you need to sign a form agreeing to help us.

Young People's Assent Form

Please complete this form after you have read the Information Sheet and listened to an explanation about the research.

Title of Study: "Evaluating the impact of urban regeneration on young people and their families"

Queen Mary Research Ethics Committee Ref: QMREC2011/40

- Thank you for considering taking part in this research. The person organising the research will have explained the project to you before you agree to take part.
- If you have any questions arising from the Information Sheet or explanation already given to you, please ask the researcher before you decide whether to join in. You will be given a copy of this Assent Form to keep and refer to at any time.
- *I understand that if I no longer wish to participate in this research, I can notify the researchers involved and be withdrawn from it immediately.*
- *I assent to the use of my personal information for the purposes of this research study. I understand that such information will be treated as strictly confidential and handled in accordance with the provisions of the Data Protection Act 1998.*

Participant's Statement:

I (write your name here)_____ agree that the research project named above has been explained to me to my satisfaction and I agree to take part in the study. I have read both the notes written above and the Information Sheet about the project, and understand what the research study involves. The research team may be kept informed of which school I attend if I leave this school

Signed: Date:

For Official Use Only (Do NOT fill in)

Investigator's Statement:

I _____ confirm that I have carefully explained the nature, demands and any foreseeable risks (where applicable) of the proposed research to the volunteer

8.4 Appendix 4: Questionnaire Items Relevant to PhD

Olympic Regeneration in East London

Your answers are CONFIDENTIAL

Nobody other than the research team will know what your answers are.

They will NOT be seen by your parents or teachers.

Please read each question carefully before ticking the boxes.

There are no right or wrong answers.

Your views are important to us.

Enjoy!

ORiEL study
Queen Mary University of London
Tel: 020 7882 2039

You and your Family

1. Are you **male** or **female**? Male ☐1 Female ☐2

2. What is your **date of birth**? _____/_____/_____
day month year

3. Does your **Mum** or **Step-Mum** that **you live with** have a job?

✓ **ONE box only**

Don't live with Mum or Step-Mum ☐1

Mum or Step-Mum has a job ☐2

Mum or Step-Mum is a student ☐3

Mum or Step-Mum does not have a job ☐4

4. Does your **Dad** or **Step-Dad** that **you live with** have a job?

✓ **ONE box only**

Don't live with Dad or Step-Dad ☐1

Dad or Step-Dad has a job ☐2

Dad or Step-Dad is a student ☐3

Dad or Step-Dad does not have a job ☐4

5. Do you have **free school meals**? No ☐1 Yes ☐2

6. Do you have **your own bedroom** for yourself?

No	Yes
☐0	☐1

7. Does your family **own a car, van or truck**?

No	Yes, one	Yes, two or more
☐0	☐1	☐2

8. During the past 12 months, how many times did you **travel away on holiday** with your family?

Not at all	Once	Twice	More than twice
☐0	☐1	☐2	☐3

9. How many **computers** does your family own? eg. Laptop, PC, iPad, tablet. (Do **NOT** include games consoles. e.g. PS3)

None	One	Two	More than two
☐0	☐1	☐2	☐3

Who you are

10. Which ONE **category** best describes **you?** - This is your race or ethnic group

✓ **ONE box only**

White UK/British	☐ 1
White Irish	☐ 2
White Lithuanian	☐ 3
White Albanian	☐ 4
White Kurdish	☐ 5
White Turkish	☐ 6
White Polish	☐ 7
Any other White background	☐ 8 (please write in) _____
Black Caribbean	☐ 9
Black African	☐ 10
Black Somali	☐ 11
Black British	☐ 12
Any other Black background	☐ 13 (please write in) _____
Indian	☐ 14
Pakistani	☐ 15
Bangladeshi	☐ 16
Any other Asian background	☐ 17 (please write in) _____
Mixed White and Black Caribbean	☐ 18
Mixed White and Black African	☐ 19
Mixed White and Asian	☐ 20
Any other Mixed background	☐ 21 (please write in) _____
Arab	☐ 22
Vietnamese	☐ 23
Any other background	☐ 24 (please write in) _____

About You

Below are some statements **about feelings and thoughts**. Please tick the box that best **describes your experience** of each **over the last 2 weeks**

✓ **ONE box on EVERY line**

	None of the time	Rarely	Some of the time	Often	All of the time
I've been feeling hopeful about the future	☐1	☐2	☐3	☐4	☐5
I've been feeling useful	☐1	☐2	☐3	☐4	☐5
I've been feeling relaxed	☐1	☐2	☐3	☐4	☐5
I've been feeling interested in other people	☐1	☐2	☐3	☐4	☐5
I've had energy to spare	☐1	☐2	☐3	☐4	☐5
I've been dealing with problems well	☐1	☐2	☐3	☐4	☐5
I've been thinking clearly	☐1	☐2	☐3	☐4	☐5
I've been feeling good about myself	☐1	☐2	☐3	☐4	☐5
I've been feeling close to other people	☐1	☐2	☐3	☐4	☐5
I've been feeling confident	☐1	☐2	☐3	☐4	☐5
I've been able to make up my own mind about things	☐1	☐2	☐3	☐4	☐5
I've been feeling loved	☐1	☐2	☐3	☐4	☐5
I've been interested in new things	☐1	☐2	☐3	☐4	☐5
I've been feeling cheerful	☐1	☐2	☐3	☐4	☐5

PLEASE CHECK: Have you ticked ONE box on EVERY LINE???

More About You

These questions are about **how you might have been feeling or acting recently.** For each question please check **how much you have felt or acted in this way in the past two weeks.**

If a sentence was true about you most of the time, tick TRUE. If it was only sometimes true, tick SOMETIMES. If a sentence was not true about you, tick NOT TRUE.

✓ **ONE box on EVERY line**

	True	Sometimes true	Not true
I felt miserable or unhappy	☐2	☐1	☐0
I didn't enjoy anything at all	☐2	☐1	☐0
I felt so tired I just sat around and did nothing	☐2	☐1	☐0
I was very restless	☐2	☐1	☐0
I felt I was no good anymore	☐2	☐1	☐0
I cried a lot	☐2	☐1	☐0
I found it hard to think properly or concentrate	☐2	☐1	☐0
I hated myself	☐2	☐1	☐0
I was a bad person	☐2	☐1	☐0
I felt lonely	☐2	☐1	☐0
I thought nobody really loved me	☐2	☐1	☐0
I thought I could never be as good as other kids	☐2	☐1	☐0
I did everything wrong	☐2	☐1	☐0

PLEASE CHECK: Have you ticked ONE box on EVERY LINE???

11. Thinking about the **past 2 weeks**, please say how true each of the following statements is for you.

✓ **ONE box on EVERY line**

	Not at all	A little bit	Somewhat	Very much	Extremely
Fear of embarrassment causes me to avoid doing things or speaking to people	☐0	☐1	☐2	☐3	☐4
I avoid activities in which I am the centre of attention	☐0	☐1	☐2	☐3	☐4
Being embarrassed or looking stupid are among my worst fears	☐0	☐1	☐2	☐3	☐4

People Around You

12. We are interested in **how you feel about the following statements.** Read each statement carefully and indicate how you feel about each statement. (**Neutral** means you **do not agree or disagree**)

✓ **ONE box on EVERY line**

	Disagree very strongly	Disagree strongly	Disagree mildly	Neutral	Agree mildly	Agree strongly	Agree very strongly
There is a special person who is around when I am in need	☐1	☐2	☐3	☐4	☐5	☐6	☐7
There is a special person with whom I can share my joys and sorrows	☐1	☐2	☐3	☐4	☐5	☐6	☐7
My family really tries to help me	☐1	☐2	☐3	☐4	☐5	☐6	☐7
I get the emotional help and support I need from my family	☐1	☐2	☐3	☐4	☐5	☐6	☐7
I have a special person who is a real source of comfort to me	☐1	☐2	☐3	☐4	☐5	☐6	☐7
My friends really try to help me	☐1	☐2	☐3	☐4	☐5	☐6	☐7
I can count on my friends when things go wrong	☐1	☐2	☐3	☐4	☐5	☐6	☐7
I can talk about my problems with my family	☐1	☐2	☐3	☐4	☐5	☐6	☐7
I have friends with whom I can share my joys and sorrows	☐1	☐2	☐3	☐4	☐5	☐6	☐7
There is a special person in my life who cares about my feelings	☐1	☐2	☐3	☐4	☐5	☐6	☐7
My family is willing to help me make decisions	☐1	☐2	☐3	☐4	☐5	☐6	☐7
I can talk about my problems with my friends	☐1	☐2	☐3	☐4	☐5	☐6	☐7

PLEASE CHECK: Have you ticked ONE box on EVERY LINE???

Some Questions About the Internet

13. How often do you use **instant messaging** services (e.g. BBM, Whatsapp, iChat)?

✓ **ONE box only**

Several times a day	Every day or almost everyday	Once or twice a week	Less than once a week	Never
☐1	☐2	☐3	☐4	☐5

14. Do you have your **own** profile on a **social networking** site (e.g. Facebook) that you currently use?

No	Yes
☐1	☐2

15. In the **past month** how often have you visited a **social networking profile** (yours or someone else's)?

✓ **ONE box only**

Several times a day	Every day or almost everyday	Once or twice a week	Less than once a week	Never	I do not have a social networking profile
☐1	☐2	☐3	☐4	☐5	☐6

16. Which of the following social networking sites do you use **most**?

✓ **ALL boxes that apply**

Facebook ☐1 Twitter ☐2 Instagram ☐3 Tumblr ☐4

Other(s) ☐5 (please write) _____

I do not have a social networking profile ☐6

17. Roughly **how many people** are you friends with (or follow you) on the social networking site you use **most**?

✓ **ONE box only**

Up to 10	11 to 50	51 to 100	101 to 300	Over 300	I do not have a social networking profile
☐1	☐2	☐3	☐4	☐5	☐6

18. People also communicate online with people they don't know in person. In **the past 12 months** have you…?

✓ **ONE box on EVERY line**

	No	Yes
Talked to people online who you don't know in person (e.g. people you met through the internet on Facebook etc.)	☐1	☐2
Shared personal information or personal photos with somebody you don't know in person but met online?	☐1	☐2

19. In the **past 12 months** how often have you…?

✓ **ONE box on EVERY line**

	Every day or almost every day	Once or twice a week	Once or twice a month	A few times a year	Less than a few times a year	Never
Received rude or nasty comments from someone online	☐1	☐2	☐3	☐4	☐5	☐6
Become the target of rumours spread online	☐1	☐2	☐3	☐4	☐5	☐6
Received threatening or aggressive comments online	☐1	☐2	☐3	☐4	☐5	☐6

20. Now thinking about things you might have done - in the **past 12 months**, how often have you…?

✓ **ONE box on EVERY line**

	Every day or almost every day	Once or twice a week	Once or twice a month	A few times a year	Less than a few times a year	Never
Sent rude or nasty comments to someone online	☐1	☐2	☐3	☐4	☐5	☐6
Spread rumours about someone else online	☐1	☐2	☐3	☐4	☐5	☐6
Sent threatening or aggressive comments to someone online	☐1	☐2	☐3	☐4	☐5	☐6

Home Life

21. The following are a number of statements about your family. Please rate each item as to <u>how often it TYPICALLY occurs in your home.</u>

✓ **ONE box on EVERY line**

	Never	Almost never	Sometimes	Often	Always
You fail to leave a note or let your parents know where you are going	☐1	☐2	☐3	☐4	☐5
You stay out in the evening past the time you are supposed to be home	☐1	☐2	☐3	☐4	☐5
Your parents do not know the friends you are with	☐1	☐2	☐3	☐4	☐5
You go out without a set time to be home	☐1	☐2	☐3	☐4	☐5
You go out after dark without an adult with you	☐1	☐2	☐3	☐4	☐5
Your parents get so busy that they forget where you are and what you are doing	☐1	☐2	☐3	☐4	☐5
You stay out later than you are supposed to and your parents don't know it	☐1	☐2	☐3	☐4	☐5
Your parents leave the house and don't tell you where they are going	☐1	☐2	☐3	☐4	☐5
You come home from school more than an hour past the time your parents expect you to be home	☐1	☐2	☐3	☐4	☐5
You are at home without an adult being with you	☐1	☐2	☐3	☐4	☐5

That's it!!!

Well Done!

Thanks for taking part!

Now, please **go back** and check that you have not **missed any questions….**

If you have any comments you would like to make, please write them in this box:

8.5 Appendix 5: Complete Record Analyses

Table 66: Complete record analyses: ORs and 95% CIs for associations between SNS use at baseline and depressive symptoms at follow-up (N=1581)

	Model 1			Model 2			Model 3			Model 4		
	Odds ratio	**p-val**	**95% CI**	**Odds ratio**	**p-val**	**95% CI**	**Odds ratio**	**p-val**	**95% CI**	**Odds ratio**	**p-val**	**95% CI**
SNS several times a day	1.11	0.520	[0.81, 1.53]	1.17	0.356	[0.84, 1.63]	1.19	0.320	[0.85, 1.66]	1.16	0.423	[0.80, 1.68]
SNS every day or almost every day†	1.00	-	-	1.00		-	1.00	-	-	1.00	-	-
SNS once or twice a week or less often	0.77	0.082	[0.57, 1.03]	0.91	0.564	[0.67, 1.25]	0.94	0.714	[0.69, 1.29]	1.00	0.979	[0.71, 1.41]
SNS never	0.71	0.062	[0.50, 1.02]	0.81	0.258	[0.56, 1.17]	0.83	0.339	[0.57, 1.21]	0.92	0.698	[0.62, 1.38]
			R^2	χ^2	*p-val*	R^2	χ^2	*p-val*	R^2	χ^2	*p-val*	R^2
Pseudo R^2			*0.005*			*0.063*			*0.072*			*0.181*
LR test				*102.02*	*<0.001*		*16.30*	*0.233*		*192.50*	*<0.001*	

Model 1: Unadjusted; Model 2: Adjusted for gender; Model 3: Additionally adjusted for ethnicity and SES; Model 4: Additionally adjusted for baseline depressive symptoms. Note: Not adjusted for school (estimates become too small)

Table 67: Complete record analyses: ORs and 95% CIs for associations between SNS use at baseline and social anxiety symptoms at follow-up (N=1527)

	Model 1			**Model 2**			**Model 3**			**Model 4**		
	Odds ratio	**p-val**	**95% CI**	**Odds ratio**	**p-val**	**95% CI**	**Odds ratio**	**p-val**	**95% CI**	**Odds ratio**	**p-val**	**95% CI**
SNS several times a day	1.04	0.825	[0.76, 1.42]	1.06	0.739	[0.77, 1.45]	1.05	0.753	[0.76, 1.45]	1.06	0.725	[0.76, 1.49]
SNS every day or almost every day†	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
SNS once or twice a week or less often	**0.71**	**0.025**	**[0.53, 0.96]**	0.76	0.074	[0.57, 1.03]	0.77	0.085	[0.57, 1.04]	0.74	0.067	[0.54, 1.02]
SNS never	0.79	0.167	[0.57, 1.10]	0.84	0.309	[0.60, 1.17]	0.83	0.286	[0.59, 1.17]	0.80	0.229	[0.56, 1.15]
			R^2	***χ^2***	***p-val***	***R^2***	***χ^2***	***p-val***	***R^2***	***χ^2***	***p-val***	***R^2***
Pseudo R^2			*0.004*			*0.014*			*0.019*			*0.091*
LR test				*16.69*	*<0.001*		*9.85*	*0.705*		*132.72*	*<0.001*	

Model 1: Unadjusted; Model 2: Adjusted for gender; Model 3: Additionally adjusted for ethnicity and SES; Model 4: Additionally adjusted for baseline social anxiety symptoms. Note: Not adjusted for school (estimates become too small)

Table 68: Complete record analyses: RRRs and 95% CIs for associations between SNS use at baseline and well-being at follow-up (N=1661)

	Below average well-being								Above average well-being							
	Model 1		Model 2		Model 3		Model 4		Model 1		Model 2		Model 3		Model 4	
	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI
SNS several times a day	1.25	[0.83, 1.87]	1.28	[0.85, 1.93]	1.28	[0.85, 1.94]	1.28	[0.83, 1.99]	1.18	[0.78, 1.78]	1.15	[0.76, 1.74]	1.15	[0.76, 1.75]	1.07	[0.69, 1.64]
SNS every day or almost every day†	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-
SNS once or twice a week or less often	0.92	[0.63, 1.36]	1.03	[0.70, 1.53]	1.04	[0.70, 1.54]	1.04	[0.68, 1.57]	1.21	[0.84, 1.75]	1.11	[0.77, 1.60]	1.10	[0.75, 1.59]	1.09	[0.74, 1.60]
SNS never	0.80	[0.50, 1.28]	0.88	[0.55, 1.41]	0.86	[0.53, 1.38]	0.83	[0.50, 1.37]	**1.53***	**[1.02, 2.28]**	1.42	[0.94, 2.13]	1.37	[0.91, 2.07]	1.35	[0.88, 2.06]
										R²		***R²***		***R²***		***R²***
Model fit										0.004		0.022		0.042		0.127
											χ²	***p-val***	***χ²***	***p-val***	***χ²***	***p-val***
LR test											*49.57*	*<0.001*	*50.87*	*0.003*	*222.05*	*<0.001*

Model 1: Unadjusted; Model 2: Adjusted for gender; Model 3: Additionally adjusted for ethnicity and SES; Model 4: Additionally adjusted for baseline well-being. Note: Not adjusted for school (estimates become too small); Due to small numbers, the model did not fit well in terms of estimating effects in the Asian Indian group. Base outcome: Average well-being (within 1SD of the mean).
*p<0.05; **p<0.01; ***p<0.001

Table 69: Complete record analyses: ORs and 95% CIs for associations between IM use at baseline and depressive symptoms at follow-up (N=1571)

	Model 1			Model 2			Model 3			Model 3		
SMFQ - Follow-Up	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**
IM several times a day	1.30	0.059	[0.99, 1.71]	1.27	0.101	[0.94, 1.69]	1.26	0.113	[0.95, 1.68]	1.17	0.324	[0.86, 1.59]
IM every day or almost every day†	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
IM Once or twice a week or less often	0.66	0.028	[0.46, 0.96]	0.74	0.120	[0.50, 1.08]	0.76	0.169	[0.52, 1.12]	0.74	0.161	[0.49, 1.13]
IM Never	1.26	0.243	[0.85, 1.87]	1.42	0.092	[0.94, 2.14]	1.48	0.068	[0.97, 2.24]	1.28	0.294	[0.81, 2.02]
			R^2	***χ^2***	***p-val***	***R^2***	***χ^2***	***p-val***	***R^2***	***χ^2***	***p-val***	***R^2***
Pseudo R^2			*0.010*			*0.071*			*0.078*			*0.189*
LR test				*106.73*	*<0.001*		*13.40*	*0.418*		*194.55*	*<0.001*	

Model 1: Unadjusted; Model 2: Adjusted for gender; Model 3: Additionally adjusted for ethnicity and SES; Model 4: Additionally adjusted for baseline depressive symptoms. Note: Not adjusted for school (estimates become too small)

Table 70: Complete record analyses: ORs and 95% CIs for associations between IM use at baseline and social anxiety symptoms at follow-up (N=1521)

	Model 1			**Model 2**			**Model 3**			**Model 4**		
	OR	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**
IM several times a day	**1.33**	**0.039**	**[1.01, 1.73]**	1.30	0.057	[0.99, 1.70]	**1.31**	**0.049**	**[1.00, 1.72]**	1.32	0.054	[0.99, 1.76]
IM every day or almost every day†	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
IM Once or twice a week or less often	0.96	0.821	[0.67, 1.35]	1.01	0.956	[0.72, 1.42]	1.04	0.804	[0.74, 1.47]	1.06	0.749	[0.74, 1.52]
IM Never	1.11	0.605	[0.75, 1.64]	1.16	0.466	[0.78, 1.71]	1.15	0.503	[0.77, 1.71]	0.98	0.916	[0.64, 1.49]
			R^2	***χ^2***	***p-val***	***R^2***	***χ^2***	***p-val***	***R^2***	***χ^2***	***p-val***	***R^2***
Pseudo R^2			*0.003*			*0.012*			*0.018*			*0.091*
LR test				*16.24*	*<0.001*		*11.19*	*0.595*		*131.51*	*<0.001*	

Model 1: Unadjusted; Model 2: Adjusted for gender; Model 3: Additionally adjusted for ethnicity and SES; Model 4: Additionally adjusted for baseline social anxiety symptoms. Note: Not adjusted for school (estimates become too small)

Table 71: Complete record analyses: RRRs and 95% CIs for associations between IM use at baseline and well-being at follow-up (N=1650)

	Below average well-being								**Above average well-being**							
	Model 1		**Model 2**		**Model 3**		**Model 4**		**Model 1**		**Model 2**		**Model 3**		**Model 4**	
	RRR	**RRR**	**RRR**	**95% CI**	**RRR**	**95% CI**	**RRR**	**95% CI**	**RRR**	**95% CI**	**RRR**	**95% CI**	**RRR**	**95% CI**	**RRR**	**95% CI**
IM several times a day - Baseline	**1.73****	**1.73****	**1.69****	**[1.18, 2.42]**	**1.71***	**[1.19, 2.46]**	**1.66****	**[1.13, 2.44]**	1.10	[0.79, 1.54]	1.28	[0.81, 1.57]	1.15	[0.82, 1.60]	1.14	[0.81, 1.62]
IM every day or almost every day - Baseline†	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-
IM Once or twice a week or less often - Baseline	0.99	0.99	1.07	[0.66, 1.73]	1.11	[0.68, 1.81]	1.07	[0.64, 1.79]	**1.47***	**[1.01, 2.14]**	1.38	[0.95, 2.01]	1.38	[0.94, 2.02]	1.39	[0.93, 2.06]
IM Never - Baseline	1.45	1.45	1.55	[0.92, 2.59]	1.49	[0.88, 2.52]	1.40	[0.80, 2.44]	0.91	[0.55, 1.51]	0.85	[0.51, 1.43]	0.83	[0.50, 1.40]	0.86	[0.50, 1.47]
										R²		***R²***		***R²***		***R²***
Model fit										0.007		0.028		0.047		0.138
											χ²	***p-val***	***χ²***	***p-val***	***χ²***	***p-val***
LR test											54.02	<0.001	50.27	0.003	225.71	<0.001

Model 1: Unadjusted; Model 2: Adjusted for gender; Model 3: Additionally adjusted for ethnicity and SES; Model 4: Additionally adjusted for baseline well-being. Note: Not adjusted for school (estimates become too small); Due to small numbers, the model did not fit well in terms of estimating effects in the Asian Indian group. Base outcome: Average well-being (within 1SD of the mean).
*p<0.05; **p<0.01; ***p<0.001

Table 72: Complete record analyses: ORs and 95% CIs for associations between involvement in cyberbullying at baseline and depressive symptoms at follow-up (N=1543)

	Model 1			Model 2			Model 3			Model 3		
	OR	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**
Not involved in CB†	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
Involved in CB as victim	**1.98**	**<0.001**	**[1.42, 2.74]**	**2.07**	**<0.001**	**[1.47, 2.91]**	**2.03**	**<0.001**	**[1.44, 2.88]**	**1.47**	**0.046**	**[1.01, 2.14]**
Involved in CB as bully	1.21	0.399	[0.78, 1.89]	1.30	0.266	[0.82, 2.07]	1.32	0.242	[0.83, 2.12]	1.22	0.442	[0.74, 2.01]
Involved in CB as bully-victim	**2.09**	**<0.001**	**[1.56, 2.79]**	**2.55**	**<0.001**	**[1.87, 3.46]**	**2.58**	**<0.001**	**[1.89, 3.53]**	**1.59**	**0.009**	**[1.12, 2.25]**
			R^2	***χ^2***	***p-val***	***R^2***	***χ^2***	***p-val***	***R^2***	***χ^2***	***p-val***	***R^2***
Pseudo R^2			*0.019*			*0.089*			*0.098*			*0.193*
LR test				*120.63*	*<0.001*		*15.87*	*0.256*		*163.76*	*<0.001*	

Model 1: Unadjusted; Model 2: Adjusted for gender; Model 3: Additionally adjusted for ethnicity and SES; Model 4: Additionally adjusted for baseline depressive symptoms. Note: Not adjusted for school (estimates become too small)

Table 73: Complete record analyses: ORs and 95% CIs for associations between involvement in cyberbullying at baseline and social anxiety symptoms at follow-up (N=1496)

	Model 1			**Model 2**			**Model 3**			**Model 3**		
	OR	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**
Not involved in CB†	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
Involved in CB as victim	**1.97**	**<0.001**	**[1.43, 2.71]**	**1.98**	**<0.001**	**[1.43, 2.73]**	**2.03**	**<0.001**	**[1.46, 2.81]**	**1.76**	**0.001**	**[1.25, 2.49]**
Involved in CB as bully	0.71	0.162	[0.45, 1.14]	0.72	0.173	[0.45, 1.16]	0.73	0.197	[0.45, 1.18]	0.80	0.367	[0.49, 1.30]
Involved in CB as bully-victim	**1.80**	**<0.001**	**[1.36, 2.38]**	**1.90**	**<0.001**	**[1.43, 2.52]**	**1.95**	**<0.001**	**[1.46, 2.61]**	**1.74**	**<0.001**	**[1.29, 2.36]**
			R^2	***χ^2***	***p-val***	***R^2***	***χ^2***	***p-val***	***R^2***	***χ^2***	***p-val***	***R^2***
Pseudo R^2			*0.019*			*0.030*			*0.036*			*0.095*
LR test				*20.16*	*<0.001*		*10.89*	*0.620*		*106.36*	*<0.001*	

Model 1: Unadjusted; Model 2: Adjusted for gender; Model 3: Additionally adjusted for ethnicity and SES; Model 4: Additionally adjusted for baseline social anxiety symptoms. Note: Not adjusted for school (estimates become too small)

Table 74: Complete record analyses: RRRs and 95% CIs for associations between involvement in cyberbullying at baseline and well-being at follow-up (N=1626)

	Below average well-being								**Above average well-being**							
	Model 1		**Model 2**		**Model 3**		**Model 4**		**Model 1**		**Model 2**		**Model 3**		**Model 4**	
	RRR	**RRR**	**RRR**	**95% CI**	**RRR**	**95% CI**	**RRR**	**95% CI**	**RRR**	**95% CI**	**RRR**	**95% CI**	**RRR**	**95% CI**	**RRR**	**95% CI**
Not involved in CB†	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-
Involved in CB as victim	**1.78****	**[1.18, 2.68]**	1.77	[1.17, 2.68]	**1.72***	**[1.13, 2.62]**	1.38	[0.88, 2.16]	0.82	[0.53, 1.26]	0.82	[0.53, 1.26]	0.85	[0.55, 1.32]	1.01	[0.64, 1.58]
Involved in CB as bully	0.92	[0.49, 1.70]	0.93	[0.50, 1.73]	0.92	[0.49, 1.73]	0.91	[0.47, 1.77]	1.06	[0.66, 1.69]	1.04	[0.65, 1.68]	1.01	[0.63, 1.63]	1.21	[0.74, 1.98]
Involved in CB as bully-victim	**1.64****	**[1.14, 2.34]**	1.79	[1.24, 2.58]	**1.72****	**[1.18, 2.50]**	1.33	[0.90, 1.98]	**0.63***	**[0.43, 0.93]**	0.58	[0.39, 0.87]	**0.58****	**[0.39, 0.86]**	0.72	[0.47, 1.08]
										***R*²**		***R*²**		***R*²**		***R*²**
Pseudo R^2										0.009		0.031		0.049		0.128
											***χ*²**	***p-val***	***χ*²**	***p-val***	***χ*²**	***p-val***
LR test											57.16	<0.001	45.86	0.010	203.07	<0.001

Model 1: Unadjusted; Model 2: Adjusted for gender; Model 3: Additionally adjusted for ethnicity and SES; Model 4: Additionally adjusted for baseline well-being. Note: Not adjusted for school (estimates become too small); Due to small numbers, the model did not fit well in terms of estimating effects in the Asian Indian group. Base outcome: Average well-being (within 1SD of the mean).
*p<0.05; **p<0.01; ***p<0.001

Table 75: Complete record analyses: ORs and 95% CIs for associations between number of friends on SNS most used at baseline and depressive symptoms at follow-up (N=1556)

	Model 1			Model 2			Model 3			Model 3		
	OR	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**
Doesn't use SNS	1.01	0.966	[0.69, 1.48]	0.95	0.806	[0.64, 1.41]	0.94	0.748	[0.63, 1.40]	1.00	0.983	[0.65, 1.53]
Up to 100 friends†	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
Friends online 101-300	0.96	0.806	[0.72, 1.29]	0.96	0.783	[0.71, 1.30]	0.94	0.719	[0.69, 1.29]	0.94	0.733	[0.68, 1.32]
Friends online 300+	**1.51**	**0.008**	**[1.11, 2.06]**	**1.47**	**0.019**	**[1.07, 2.02]**	**1.44**	**0.029**	**[1.04, 2.01]**	1.23	0.269	[0.85, 1.76]
			R^2	***χ^2***	***p-val***	***R^2***	***χ^2***	***p-val***	***R^2***	***χ^2***	***p-val***	***R^2***
Pseudo R^2			*0.006*			*0.065*			*0.074*			*0.183*
LR test				*103.96*	*<0.001*		*14.37*	*0.349*		*189.37*	*<0.001*	

Model 1: Unadjusted; Model 2: Adjusted for gender; Model 3: Additionally adjusted for ethnicity and SES; Model 4: Additionally adjusted for baseline depressive symptoms. Note: Not adjusted for school (estimates become too small)

Table 76: Complete record analyses: ORs and 95% CIs for associations between number of friends on SNS most used at baseline and social anxiety symptoms at follow-up (N=1498)

	Model 1			Model 2			Model 3			Model 3		
	OR	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**
Doesn't use SNS	0.71	0.080	[0.49, 1.04]	0.69	0.059	[0.47, 1.01]	**0.67**	**0.044**	**[0.46, 0.99]**	0.67	0.053	[0.45, 1.01]
Up to 100 friends†	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
Friends online 101-300	1.07	0.631	[0.82, 1.40]	1.05	0.724	[0.80, 1.38]	1.05	0.741	[0.79, 1.38]	1.09	0.556	[0.82, 1.46]
Friends online 300+	1.00	0.993	[0.73, 1.36]	0.96	0.812	[0.71, 1.31]	0.93	0.657	[0.68, 1.28]	0.97	0.876	[0.69, 1.36]
			R^2	***χ^2***	***p-val***	***R^2***	***χ^2***	***p-val***	***R^2***	***χ^2***	***p-val***	***R^2***
Pseudo R^2			*0.003*			*0.013*			*0.019*			*0.093*
LR test				*19.60*	*<0.001*		*10.52*	*0.651*		*133.18*	*<0.001*	

Model 1: Unadjusted; Model 2: Adjusted for gender; Model 3: Additionally adjusted for ethnicity and SES; Model 4: Additionally adjusted for baseline social anxiety symptoms. Note: Not adjusted for school (estimates become too small)

Table 77: Complete record analyses: RRRs and 95% CIs for associations between number of friends on SNS most used at baseline and well-being at follow-up (N=1635)

	Below average well-being								Above average well-being							
	Model 1		Model 2		Model 3		Model 4		Model 1		Model 2		Model 3		Model 4	
	RRR	**RRR**	**RRR**	**95% CI**	**RRR**	**95% CI**	**RRR**	**95% CI**	**RRR**	**95% CI**	**RRR**	**95% CI**	**RRR**	**95% CI**	**RRR**	**95% CI**
Doesn't use SNS	0.85	[0.50, 1.43]	0.83	[0.49, 1.40]	0.80	[0.47, 1.37]	0.73	[0.41, 1.28]	1.36	[0.89, 2.08]	1.39	[0.90, 2.13]	1.39	[0.90, 2.14]	1.41	[0.90, 2.22]
Up to 100 friends†	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-
Friends online 101-300	0.97	[0.67, 1.41]	0.96	[0.66, 1.40]	0.96	[0.66, 1.41]	0.95	[0.63, 1.42]	1.05	[0.74, 1.47]	1.05	[0.75, 1.49]	1.08	[0.76, 1.53]	1.03	[0.71, 1.48]
Friends online 300+	**1.54***	**[1.05, 2.26]**	**1.48***	**[1.01, 2.18]**	**1.51***	**[1.01, 2.26]**	1.37	[0.89, 2.10]	1.42	[0.98, 2.05]	**1.47***	**[1.01, 2.13]**	**1.47***	**[1.00, 2.16]**	1.44	[0.97, 2.15]
										R^2		***R^2***		***R^2***		***R^2***
Pseudo R^2										*0.004*		*0.024*		*0.043*		*0.125*
											χ^2	***p-val***	***χ^2***	***p-val***	***χ^2***	***p-val***
LR test											*49.53*	*<0.001*	*50.45*	*0.003*	*212.68*	*<0.001*

Model 1: Unadjusted; Model 2: Adjusted for gender; Model 3: Additionally adjusted for ethnicity and SES; Model 4: Additionally adjusted for baseline well-being. Note: Not adjusted for school (estimates become too small); Due to small numbers, the model did not fit well in terms of estimating effects in the Asian Indian group; Base outcome: Average well-being (within 1SD of the mean).
*p<0.05; **p<0.01; ***p<0.001

Table 78: Complete record analyses: ORs and 95% CIs for associations between communication with strangers at baseline and depressive symptoms at follow-up (N=1512)

	Model 1			Model 2			Model 3			Model 3		
	OR	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**
No communication with strangers online†	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
Communication with strangers online	**1.53**	**0.001**	**[1.18, 1.98]**	**1.78**	**<0.001**	**[1.35, 2.34]**	**1.81**	**<0.001**	**[1.37, 2.38]**	**1.58**	**0.003**	**[1.17, 2.13]**
			R^2	***χ^2***	***p-val***	***R^2***	***χ^2***	***p-val***	***R^2***	***χ^2***	***p-val***	***R^2***
Pseudo R^2			*0.006*			*0.069*			*0.078*			*0.188*
LR test				*106.93*	*<0.001*		*15.93*	*0.253*		*185.71*	*<0.001*	

Model 1: Unadjusted; Model 2: Adjusted for gender; Model 3: Additionally adjusted for ethnicity and SES; Model 4: Additionally adjusted for baseline depressive symptoms. Note: Not adjusted for school (estimates become too small)

Table 79: Complete record analyses: ORs and 95% CIs for associations between communication with strangers at baseline and social anxiety symptoms at follow-up (N=1465)

	Model 1			Model 2			Model 3			Model 3		
	OR	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**
No communication with strangers online†	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
Communication with strangers online	**1.48**	**0.002**	**[1.14, 1.91]**	**1.56**	**0.001**	**[1.20, 2.01]**	**1.55**	**0.001**	**[1.20, 2.01]**	**1.39**	**0.018**	**[1.06, 1.82]**
			R^2	***χ^2***	***p-val***	***R^2***	***χ^2***	***p-val***	***R^2***	***χ^2***	***p-val***	***R^2***
Pseudo R^2			*0.005*			*0.018*			*0.023*			*0.091*
LR test				*22.31*	*<0.001*		*9.73*	*0.716*		*120.52*	*<0.001*	

Model 1: Unadjusted; Model 2: Adjusted for gender; Model 3: Additionally adjusted for ethnicity and SES; Model 4: Additionally adjusted for baseline social anxiety symptoms. Note: Not adjusted for school (estimates become too small)

Table 80: Complete record analyses: RRRs and 95% CIs for associations between communication with strangers at baseline and well-being at follow-up (N=1589)

	Below average well-being								Above average well-being							
	Model 1		Model 2		Model 3		Model 4		Model 1		Model 2		Model 3		Model 4	
	RRR	RRR	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI
No communication with strangers online†	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-
Communication with strangers online	1.28	[0.92, 1.78]	1.38	[0.98, 1.93]	1.37	[0.97, 1.93]	1.28	[0.89, 1.84]	0.98	[0.71, 1.36]	0.93	[0.67, 1.28]	0.91	[0.66, 1.27]	0.98	[0.70, 1.37]
										R²		***R²***		***R²***		***R²***
Pseudo R^2										0.001		0.022		0.042		0.129
											χ^2	***p-val***	***χ^2***	***p-val***	***χ^2***	***p-val***
LR test											52.52	<0.001	50.49	0.003	217.17	<0.001

Model 1: Unadjusted; Model 2: Adjusted for gender; Model 3: Additionally adjusted for ethnicity and SES; Model 4: Additionally adjusted for baseline well-being. Note: Not adjusted for school (estimates become too small); Due to small numbers, the model did not fit well in terms of estimating effects in the Asian Indian group. Base outcome: Average well-being (within 1SD of the mean).
*p<0.05; **p<0.01; ***p<0.001

8.6 Appendix 6: Sensitivity Analyses for Cyberbullying

- Main cyberbullying analyses with additional adjustment for “ever bullied” item from negative life events questionnaire

Table 81: ORs and 95% CIs for associations between cyberbullying involvement at baseline and depressive symptoms at follow-up with adjustment for "ever bullied item" using the imputed data

	Model 1			Model 2			Model 3			Model 4		
	OR	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**
Not involved in cyberbullying†	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
Cybervictim	**1.96**	**<0.001**	**[1.45,2.67]**	**2.02**	**<0.001**	**[1.47, 2.79]**	**1.59**	**0.007**	**[1.14,2.23]**	1.26	0.214	[0.87, 1.81]
Cyberbully	1.21	0.323	[0.83,1.77]	1.28	0.228	[0.86, 1.91]	1.31	0.202	[0.87,1.98]	1.19	0.431	[0.77, 1.85]
Cyberbully-victim	**2.14**	**<0.001**	**[1.66,2.76]**	**2.46**	**<0.001**	**[1.86, 3.21]**	**2.12**	**<0.001**	**[1.60,2.81]**	**1.44**	**0.023**	**[1.05, 1.96]**
Never bullied							1.00	-	-	1.00	-	-
Bullied in lifetime							**2.36**	**<0.001**	**[1.89,2.95]**	**1.89**	**<0.001**	**[1.49, 2.40]**
	F	***P-val***		***F***	***P-val***		***F***	***P-val***		***F***	***P-val***	
Model fit	*13.74*	*<0.001*		*35.70*	*<0.001*		*6.07*	*<0.001*		*9.41*	*<0.001*	
Wald test				*134.34*	*<0.001*		*2.78*	*<0.001*		*208.95*	*<0.001*	

Model 1: Unadjusted; Model 2: Adjusted for gender; Model 3: Additionally adjusted for ethnicity, SES, and "ever bullied item"; Model 4: Additionally adjusted for baseline depressive symptoms. Note: Based on imputed data; additionally adjusted for school (not presented)

Table 82: ORs and 95% CIs for associations between cyberbullying involvement at baseline and social anxiety symptoms at follow-up with adjustment for "ever bullied item" using the imputed data

	Model 1			Model 2			Model 3			Model 4		
	OR	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**	**OR**	**p-val**	**95% CI**
Not involved in cyberbullying†	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
Cybervictim	**1.68**	**<0.001**	**[1.27,2.22]**	**1.68**	**<0.001**	**[1.27, 2.23]**	**1.45**	**0.018**	**[1.07,1.96]**	1.35	0.068	[0.98, 1.86]
Cyberbully	0.79	0.240	[0.53,1.17]	0.80	0.281	[0.54, 1.19]	0.80	0.285	[0.53,1.20]	0.84	0.427	[0.55, 1.29]
Cyberbully-victim	**1.52**	**0.001**	**[1.19,1.94]**	**1.60**	**<0.001**	**[1.25, 2.05]**	**1.44**	**0.006**	**[1.11,1.87]**	**1.32**	**0.045**	**[1.01, 1.74]**
Never bullied							1.00	-	-	1.00	-	-
Bullied in lifetime							**2.09**	**<0.001**	**[1.70,2.58]**	**1.73**	**<0.001**	**[1.39, 2.17]**
	F	***P-val***		***F***	***P-val***		***F***	***P-val***		***F***	***P-val***	
Model fit	*8.08*	*<0.001*		*15.20*	*<0.001*		*3.84*	*<0.001*		*6.29*	*<0.001*	
Wald test				*42.51*	*<0.001*		*2.67*	*<0.001*		*119.88*	*<0.001*	

Model 1: Unadjusted; Model 2: Adjusted for gender; Model 3: Additionally adjusted for ethnicity, SES, and "ever bullied item"; Model 4: Additionally adjusted for baseline social anxiety symptoms. Note: Based on imputed data; additionally adjusted for school (not presented)

Table 83: RRRs and 95% CIs for associations between cyberbullying involvement at baseline and well-being at follow-up with adjustment for "ever bullied item" using the imputed data

	Below average well-being								Above average well-being							
	Model 1		Model 2		Model 3		Model 4		Model 1		Model 2		Model 3		Model 4	
	RRR	RRR	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI
Not involved in CB†	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-
Involved in CB as victim	**1.55***	**[1.09, 2.21]**	**1.56***	**[1.09, 2.23]**	1.34	[0.91, 1.97]	1.17	[0.77, 1.76]	0.71	[0.49, 1.03]	0.71	[0.49, 1.03]	0.75	[0.51, 1.10]	0.86	[0.57, 1.29]
Involved in CB as bully	1.09	[0.63, 1.90]	**1.12**	**[0.64, 1.94]**	1.11	[0.63, 1.95]	1.08	[0.60, 1.94]	0.96	[0.63, 1.48]	0.94	[0.61, 1.45]	0.91	[0.58, 1.42]	1.01	[0.63, 1.62]
Involved in CB as bully-victim	**1.65****	**[1.19, 2.28]**	**1.74****	**[1.25, 2.42]**	**1.58***	**[1.11, 2.25]**	1.30	[0.90, 1.89]	**0.68***	**[0.48, 0.96]**	**0.64***	**[0.46, 0.91]**	**0.66***	**[0.46, 0.94]**	0.80	[0.54, 1.16]
Never bullied					1.00	-	1.00	-					1.00	-	1.00	-
Bullied in lifetime					**1.74*****	**[1.32, 2.30]**	**1.47****	**[1.10, 1.97]**					**0.73***	**[0.55, 0.99]**	**0.82**	**[0.61, 1.12]**
									F	***P-val***	***F***	***P-val***	***F***	***P-val***	***F***	***P-val***
Model fit									*3.61*	*0.001*	*8.97*	*<0.001*	*2.40*	*<0.001*	*5.01*	*<0.001*
Wald test											*29.54*	*<0.001*	*1.73*	*<0.001*	*72.15*	*<0.001*

Model 1: Unadjusted; Model 2: Adjusted for gender; Model 3: Additionally adjusted for ethnicity, SES, and "ever bullied item"; Model 4: Additionally adjusted for baseline well-being. Note: Additionally adjusted for school (not presented); based on imputed data; *p<0.05, **p<0.001, ***p<0.001. Base outcome: Average well-being (within 1 SD of mean)

8.7 Appendix 7: Testing interactions: Cross-sectional analysis of the complete record follow-up data

As discussed in Chapter Five, it was not possible to test the interaction effects using the complete record data due to limitations in power and the multiple imputation. Chapter Five details the stratified longitudinal analyses which were carried out to examine the potential role of gender, perceived social support from peers and family, and parental monitoring as moderators in associations between social media characteristics and adolescent mental health. The results discussed in this appendix detail an alternative approach to examining the role of these potential moderators. Missing data was less of an issue at follow-up compared to the baseline survey and as such there was a larger sample of participants available using the cross-sectional follow-up data compared to the baseline data. Therefore, in order to examine interaction effects in this data, additional analyses reported here illustrate the evidence to suggest a moderating role of gender, perceived social support from peers and family, and parental monitoring as moderators in associations between social media characteristics and adolescent mental health.

First, analyses were carried out to test for interaction effects. This involved regressing each of the mental health constructs (depressive symptoms, social anxiety symptoms, and well-being) on the social media characteristic variables (SNS use, IM use, cyberbullying involvement, network size online, and communication online with strangers) while also testing for the moderating role of gender, perceived social support from peers and family, and parental monitoring. Similar to the main analyses, these analyses were carried out in three steps – unadjusted, adjusted for gender (with the exception of the analyses which examined the moderating role of gender), and additionally adjusted for ethnicity, SES, and school.

8.7.1 Gender Interactions

Tests of the interaction between gender and SNS use, IM use cyberbullying involvement, network size, and communication with strangers in associations with depressive symptoms, social anxiety symptoms, and mental well-being suggested evidence for two gender interactions.

First, test of the interaction effect revealed that the relative risk of reporting below average well-being was 2.08 times greater for females who used SNS several times a day compared to males ($p=0.044$, 95% CI [1.02, 4.25]) after adjusting for ethnicity, SES, and school. Second, tests for an interaction effect in the fully adjusted model indicated a 56% decrease in relative risk ratio for above average well-being for females with over 300 friends compared to males ($p=0.026$, 95% CI [0.22, 0.91]). For all other models, the data did not

provide evidence for an interaction with gender. Where there was evidence for an interaction the analytic models have been run separately by gender.

Based on this evidence for a moderating effect of gender in associations between SNS use and mental well-being, stratified analyses were then carried out. The stratified analyses in Table 84 indicated that females who used SNS several times a day had an 87% increase in risk of reporting below average well-being than females who used SNS daily or almost daily. There was insufficient evidence to suggest a difference in risk of reporting below average well-being based on frequency of SNS use among males.

In terms of gender differences in associations between online network size and above average well-being, the stratified analyses illustrated in Table 84 suggest that males with over 300 friends online had a 59% increase in risk of reporting above average well-being compared to males with up to 100 friends online. Among females, there was no difference between those with up to 100 friends online and those with over 300 friends online in terms of reports of above average well-being.

Table 84: Gender stratified analyses: RRR and confidence intervals for the association between SNS use and network size and mental well-being

	Below Average Well-Being[c]						Above Average Well-Being[c]					
	Model 1[a]			Model 2[b]			Model 1[a]			Model 2[b]		
	RRR	p-val	95%CI	RRR	p-val	95%CI	RRR	p-val	95%CI	RRR	p-val	95%CI
SNS AND WELL-BEING (N=1141)												
MALE												
SNS several times a day	0.93	0.786	[0.53, 1.62]	0.89	0.682	[0.49, 1.59]	0.93	0.786	[0.53, 1.62]	**1.70**	**0.019**	**[1.09, 2.64]**
SNS every day or almost daily	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
SNS twice a week or less	1.35	0.260	[0.80, 2.27]	1.30	0.340	[0.76, 2.25]	1.35	0.260	[0.80, 2.27]	1.33	0.224	[0.84, 2.12]
SNS never	**1.91**	**0.021**	**[1.10, 3.31]**	**1.96**	**0.021**	**[1.11, 3.48]**	**1.91**	**0.021**	**[1.10, 3.31]**	1.57	0.082	[0.94, 2.61]
FEMALE (N=978)												
SNS several times a day	**1.76**	**0.006**	**[1.17, 2.64]**	**1.87**	**0.005**	**[1.21, 2.88]**	1.61	0.102	[0.91, 2.86]	1.73	0.078	[0.94, 3.17]
SNS every day or almost daily	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
SNS twice a week or less	1.11	0.672	[0.69, 1.80]	1.00	0.994	[0.60, 1.66]	1.35	0.364	[0.71, 2.58]	1.41	0.333	[0.71, 2.80]
SNS never	1.18	0.569	[0.67, 2.09]	1.22	0.535	[0.65, 2.27]	**2.12**	**0.031**	**[1.07, 4.21]**	**2.13**	**0.047**	**[1.01, 4.48]**
NETWORK SIZE												
MALE (N=1123)												
No SNS profile	1.44	0.204	[0.82, 2.54]	1.42	0.242	[0.79, 2.57]	1.31	0.317	[0.77, 2.23]	1.27	0.402	[0.73, 2.21]
Up to 100 friends online	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-

100-300 friends online	0.55	0.030	[0.32, 0.94]	0.51	0.021	[0.29, 0.90]	1.02	0.938	[0.66, 1.56]	1.08	0.741	[0.69, 1.69]
300+ Friends online	0.97	0.904	[0.61, 1.56]	0.97	0.921	[0.59, 1.61]	**1.64**	**0.014**	**[1.11, 2.43]**	**1.59**	**0.030**	**[1.05, 2.42]**
FEMALE (N=965)												
No SNS profile	0.95	0.861	[0.52, 1.72]	1.01	0.984	[0.52, 1.93]	1.34	0.419	[0.66, 2.70]	1.41	0.378	[0.66, 3.03]
Up to 100 friends online	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
100-300 friends online	0.74	0.202	[0.47, 1.17]	0.65	0.089	[0.40, 1.07]	0.70	0.243	[0.38, 1.28]	0.68	0.246	[0.36, 1.30]
300+ Friends online	0.92	0.674	[0.61, 1.38]	0.88	0.563	[0.56, 1.37]	0.72	0.245	[0.41, 1.25]	0.67	0.183	[0.37, 1.21]

a. Model 1: Unadjusted
b. Model 2: Adjusted for ethnicity, SES, and school
c. Multinomial logistic regression: Base outcome – Average well-being

8.7.2 Interactions with Perceived Social Support from Peers

Tests of the interaction between perceived social support from peers and SNS use, IM use cyberbullying involvement, network size, and communication with strangers in associations with depressive symptoms, social anxiety symptoms, and mental well-being suggested evidence for a peer support interaction in the association between SNS use and depressive symptoms, and between cyberbullying involvement and above average well-being. The interaction tests did not suggest a moderating effect of perceived peer support in any of the other associations between social media characteristics and mental health in the follow-up cross-sectional data.

First, focusing on the moderating effect of perceived social support from peers in cross-sectional associations between SNS use and depressive symptoms, there was a 2.35 fold increase in odds of reporting depressive symptoms for those with medium peer support who used SNS several times a day compared to those reporting high levels of perceived peer support (p=0.015, 95% CI [1.18, 4.68]). The results of the stratified analyses are presented in Table 85, below. Among those with medium levels of perceived peer support, SNS use several times a day was associated with a 1.99 increase in odds of reporting depressive symptoms. However, the stratified analyses do not provide evidence to suggest an association between frequency of SNS use and depressive symptoms among those with low levels of perceived peer support or those with high levels of perceived peer support.

Table 85: Perceived peer support stratified analyses: OR and confidence intervals for the association between SNS use and depressive symptoms

	Model 1[a]			Model 2[b]			Model 3[c]		
	OR	**p-val**	**95%CI**	**OR**	**p-val**	**95%CI**	**OR**	**p-val**	**95%CI**
LOW PEER SUPPORT (N=692)									
SNS several times a day	1.18	0.463	[0.76, 1.82]	1.00	0.997	[0.63, 1.58]	1.05	0.837	[0.64, 1.73]
SNS every day or almost every day	1.00	-	-	1.00	-	-	1.00	-	-
SNS twice a week or less	0.76	0.218	[0.48, 1.18]	0.76	0.257	[0.48, 1.22]	0.82	0.442	[0.50, 1.36]
SNS never	0.62	0.067	[0.37, 1.03]	0.70	0.190	[0.41, 1.19]	0.69	0.203	[0.39, 1.22]
MEDIUM PEER SUPPORT (N=801)									
SNS several times a day	**1.69**	**0.016**	**[1.10, 2.60]**	**1.77**	**0.011**	**[1.14, 2.75]**	**1.99**	**0.004**	**[1.24, 3.17]**
SNS every day or almost every day	1.00	-	-	1.00	-	-	1.00	-	-
SNS twice a week or less	1.21	0.436	[0.75, 1.93]	1.36	0.216	[0.84, 2.21]	1.37	0.238	[0.81, 2.29]
SNS never	1.33	0.308	[0.77, 2.31]	1.61	0.101	[0.91, 2.86]	1.62	0.126	[0.87, 3.02]
HIGH PEER SUPPORT (N=602[d])									
SNS several times a day	0.87	0.584	[0.54, 1.42]	0.84	0.498	[0.51, 1.39]	0.74	0.291	[0.42, 1.30]
SNS every day or almost every day	1.00	-	-	1.00	-	-	1.00	-	-
SNS twice a week or less	0.68	0.206	[0.37, 1.23]	0.73	0.314	[0.40, 1.35]	0.57	0.104	[0.29, 1.12]
SNS never	0.52	0.071	[0.25, 1.02]	0.50	0.063	[0.24, 1.04]	0.56	0.161	[0.25, 1.26]

a. Model 1: Unadjusted
b. Model 2: Adjusted for gender
c. Model 3: Additionally adjusted for ethnicity, SES, and school
d. NOTE: School 8 dropped - issues of perfect prediction (18 observations affected)

There was also evidence to suggest that the risk of reporting above average well-being was 3.62 times greater for cyberbully-victims with medium perceived peer support compared to high perceived peer support. The stratified analyses in Table 86 did not provide evidence for an association between cyberbullying involvement and above average well-being among those with low or medium levels of peer support. However, among those with high levels of perceived peer support, involvement in cyberbullying as a cyberbully-victim was associated with an 81% reduction in risk of reporting above average well-being compared to those uninvolved in cyberbullying.

Table 86: Perceived peer support stratified analyses: RRR and confidence intervals for the association between cyberbullying involvement and above average well-being

	Above Average Well-Being[d]								
	Model 1[a]			Model 2[b]			Model 3[c]		
	RRR	p-val	95%CI	RRR	p-val	95%CI	RRR	p-val	95%CI
LOW PEER SUPPORT (N=631)									
Not involved	1.00	-	-	1.00	-	-	1.00	-	-
Cybervictim	0.64	0.303	[0.27, 1.50]	0.74	0.489	[0.31, 1.74]	0.57	0.251	[0.22, 1.48]
Cyberbully	0.92	0.902	[0.26, 3.27]	0.90	0.877	[0.25, 3.23]	0.75	0.698	[0.18, 3.21]
Cyberbully-victim	0.57	0.129	[0.27, 1.18]	0.54	0.096	[0.26, 1.12]	0.45	0.052	[0.20, 1.01]
MEDIUM PEER SUPPORT (N=757)									
Not involved	1.00	-	-	1.00	-	-	1.00	-	-
Cybervictim	0.70	0.354	[0.33, 1.48]	0.72	0.382	[0.34, 1.51]	0.60	0.216	[0.27, 1.35]
Cyberbully	1.65	0.212	[0.75, 3.61]	1.61	0.239	[0.73, 3.53]	1.59	0.310	[0.65, 3.89]
Cyberbully-victim	0.72	0.346	[0.36, 1.43]	0.69	0.295	[0.35, 1.38]	0.65	0.256	[0.30, 1.37]
HIGH PEER SUPPORT (N=561)									
Not involved	1.00	-	-	1.00	-	-	1.00	-	-
Cybervictim	**0.49**	**0.027**	**[0.26, 0.92]**	0.60	0.120	[0.31, 1.14]	0.59	0.140	[0.29, 1.19]
Cyberbully	0.90	0.751	[0.45, 1.76]	0.83	0.599	[0.41, 1.67]	0.95	0.906	[0.44, 2.06]
Cyberbully-victim	**0.19**	**0.001**	**[0.07, 0.48]**	**0.17**	**<0.001**	**[0.07, 0.45]**	**0.19**	**0.001**	**[0.07, 0.51]**

a. Model 1: Unadjusted
b. Model 2: Adjusted for gender
c. Model 3: Additionally adjusted for ethnicity, SES, and school
d. Multinomial logistic regression: Base outcome – Average well-being

8.7.3 Interactions with Perceived Family Support

Tests of the interaction between perceived social support from family and SNS use, IM use cyberbullying involvement, network size, and communication with strangers in associations with depressive symptoms, social anxiety symptoms, and mental well-being suggested evidence for a family support interaction in the association between SNS use and depressive symptoms, the association between IM use and depressive symptoms, the association between cyberbullying involvement and above average well-being, and in the association between online network size and above average mental well-being. The interaction tests did not suggest a moderating effect of perceived family support in any of the other associations between social media characteristics and mental health in the follow-up cross-sectional data.

In terms of depressive symptoms, SNS use twice a week or less often was associated with a 56% reduction in odds of reporting depressive symptoms for those with low perceived family support compared to those with high perceived family support (p=0.044, 95% CI [0.20, 0.98]). However, the stratified analyses detailed in Table 87 do not suggest an association between SNS use and depressive symptoms at any of the three levels of perceived family support.

The tests of the interaction between perceived family support and social media variables in associations with mental health in the follow-up cross-sectional data also provided evidence for an interaction with IM use. For those who reported medium levels of perceived social support from family and used IM several times a day the odds of reporting depressive symptoms were 2.04 times greater compared to those with high perceived social support from family (p=0.042, 95% CI [1.03, 4.07]). The stratified analyses detailed in Table 87 indicate that among those with medium family support, use of IM several times a day the odds of reporting depressive symptoms were 1.67 times greater compared to those with medium family support who reported using IM every day or almost daily. The results did not suggest evidence for an association between IM use and depressive symptoms among those with low or high levels of perceived family support.

Table 87: Perceived family support stratified analyses: OR and confidence intervals for the association between SNS use and IM use and depressive symptoms

	Model 1[a]			Model 2[b]			Model 3[c]		
	OR	**p-val**	**95%CI**	**OR**	**p-val**	**95%CI**	**OR**	**p-val**	**95%CI**
SNS AND DEPRESSIVE SYMPTOMS									
LOW FAMILY SUPPORT (N=768)									
SNS several times a day	1.22	0.307	[0.83, 1.79]	1.07	0.727	[0.72, 1.60]	1.12	0.605	[0.73, 1.72]
SNS every day or almost every day	1.00	-	-	1.00	-	-	1.00	-	-
SNS twice a week or less	0.79	0.252	[0.53, 1.18]	0.83	0.403	[0.54, 1.28]	0.83	0.436	[0.53, 1.32]
SNS never	0.76	0.270	[0.46, 1.24]	0.92	0.767	[0.55, 1.56]	0.94	0.825	[0.53, 1.66]
MEDIUM FAMILY SUPPORT (N=660)									
SNS several times a day	1.12	0.645	[0.70, 1.78]	1.13	0.612	[0.70, 1.83]	1.36	0.236	[0.82, 2.28]
SNS every day or almost every day	1.00	-	-	1.00	-	-	1.00	-	-
SNS twice a week or less	0.67	0.158	[0.39, 1.17]	0.78	0.380	[0.44, 1.37]	0.85	0.598	[0.47, 1.55]
SNS never	1.25	0.449	[0.70, 2.24]	1.44	0.234	[0.79, 2.63]	1.75	0.093	[0.91, 3.36]
HIGH FAMILY SUPPORT (N=674)									
SNS several times a day	1.54	0.163	[0.84, 2.83]	1.52	0.181	[0.82, 2.81]	1.68	0.123	[0.87, 3.26]
SNS every day or almost every day	1.00	-	-	1.00	-	-	1.00	-	-
SNS twice a week or less	1.64	0.132	[0.86, 3.13]	1.78	0.084	[0.93, 3.43]	1.82	0.094	[0.90, 3.65]
SNS never	0.78	0.547	[0.36, 1.73]	0.85	0.692	[0.38, 1.89]	1.02	0.968	[0.43, 2.39]
IM AND DEPRESSIVE SYMPTOMS									

LOW FAMILY SUPPORT (N=772)									
IM several times a day	1.28	0.175	[0.90, 1.83]	1.13	0.522	[0.78, 1.65]	1.30	0.207	[0.86, 1.97]
IM every day or almost every day	1.00	-	-	1.00	-	-	1.00	-	-
IM twice a week or less	0.85	0.513	[0.52, 1.38]	0.91	0.701	[0.54, 1.50]	1.00	1.000	[0.58, 1.73]
IM never	1.13	0.652	[0.66, 1.94]	1.46	0.191	[0.83, 2.57]	1.55	0.159	[0.84, 2.85]
MEDIUM FAMILY SUPPORT (N=662)									
IM several times a day	**1.58**	**0.041**	**[1.02, 2.45]**	**1.60**	**0.041**	**[1.02, 2.50]**	**1.67**	**0.035**	**[1.04, 2.68]**
IM every day or almost every day	1.00	-	-	1.00	-	-	1.00	-	-
IM twice a week or less	0.96	0.894	[0.50, 1.83]	1.24	0.528	[0.64, 2.42]	1.29	0.482	[0.64, 2.59]
IM never	0.91	0.812	[0.44, 1.92]	1.10	0.798	[0.52, 2.36]	1.20	0.656	[0.54, 2.65]
HIGH FAMILY SUPPORT (N=678)									
IM several times a day	0.88	0.602	[0.54, 1.44]	0.85	0.530	[0.52, 1.40]	0.77	0.330	[0.45, 1.31]
IM every day or almost every day	1.00	-	-	1.00	-	-	1.00	-	-
IM twice a week or less	0.72	0.401	[0.34, 1.54]	0.80	0.575	[0.37, 1.73]	0.78	0.565	[0.34, 1.80]
IM never	0.52	0.202	[0.19, 1.41]	0.58	0.280	[0.21, 1.57]	0.50	0.207	[0.17, 1.47]

a. Model 1: Unadjusted
b. Model 2: Adjusted for gender
c. Model 3: Additionally adjusted for ethnicity, SES, and school

In terms of above average well-being, tests of the interaction between cyberbullying involvement and family support indicated that cyberbully-victims with medium levels of perceived social support from family had 3.24 times greater odds of reporting above average well-being compared to cyberbully-victims with high family support (p=0.037, 95% CI [1.07, 9.80]. The stratified analyses detailed in Table 88 indicate that cyberbully-victims with high levels of family support were 75% less likely to report above average well-being than their peers with high family support who are not involved in cyberbullying. There was no association between cyberbullying involvement and above average levels of mental well-being among those with low or medium levels of perceived family support.

When the moderating role of perceived family support was tested, those with 100 to 300 friends online who reported low levels of perceived family support had 3.82 times greater odds of reporting above average well-being compared to those with high levels of perceived family support (p=0.007, 95% CI [1.33, 10.14]). The stratified analyses detailed in Table 88 suggest that among those with low levels of family support, those with 100 to 300 friends online had 2.82 times greater risk of reporting above average well-being than their peers with up to 100 friends who reported low levels of family support. The stratified analyses did not suggest an association between online network size and above average well-being among those with medium or high levels of perceived family support.

Table 88: Perceived family support stratified analyses: RRR and confidence intervals for the association between cyberbullying involvement and network size and above average well-being

	Above Average Well-Being[d]								
	Model 1[a]			Model 2[b]			Model 3[c]		
	RRR	**p-val**	**95%CI**	**RRR**	**p-val**	**95%CI**	**RRR**	**p-val**	**95%CI**
CYBERBULLYING AND ABOVE AVERAGE WELL-BEING									
LOW FAMILY SUPPORT (N=716)									
Not involved	1.00	-	-	1.00	-	-	1.00	-	-
Cybervictim	0.56	0.208	[0.23, 1.38]	0.68	0.405	[0.27, 1.69]	0.54	0.224	[0.20, 1.46]
Cyberbully	0.64	0.563	[0.15, 2.86]	0.61	0.512	[0.14, 2.71]	0.46	0.369	[0.09, 2.47]
Cyberbully-victim	0.54	0.115	[0.25, 1.16]	0.52	0.097	[0.24, 1.12]	0.49	0.106	[0.21, 1.16]
MEDIUM FAMILY SUPPORT (N=607)									
Not involved	1.00	-	-	1.00	-	-	1.00	-	-
Cybervictim	0.42	0.072	[0.16, 1.08]	0.40	0.064	[0.15, 1.05]	0.45	0.139	[0.16, 1.29]
Cyberbully	1.88	0.110	[0.87, 4.07]	1.96	0.093	[0.89, 4.28]	2.11	0.109	[0.85, 5.28]
Cyberbully-victim	0.84	0.631	[0.42, 1.70]	0.77	0.474	[0.38, 1.57]	0.77	0.499	[0.35, 1.66]
HIGH FAMILY SUPPORT (N=634)									
Not involved	1.00	-	-	1.00	-	-	1.00	-	-
Cybervictim	0.75	0.326	[0.43, 1.32]	0.82	0.496	[0.46, 1.45]	0.89	0.705	[0.48, 1.64]
Cyberbully	0.98	0.957	[0.50, 1.91]	0.90	0.755	[0.46, 1.77]	0.83	0.624	[0.40, 1.72]
Cyberbully-victim	**0.28**	**0.002**	**[0.12, 0.63]**	**0.24**	**0.001**	**[0.11, 0.55]**	**0.25**	**0.001**	**[0.11, 0.58]**

FRIENDS ONLINE AND ABOVE AVERAGE WELL-BEING									
LOW FAMILY SUPPORT (N=731)									
No SNS profile	0.55	0.456	[0.12, 2.62]	0.52	0.413	[0.11, 2.47]	0.55	0.478	[0.11, 2.85]
Up to 100 friends online	1.00	-	-	1.00	-	-	1.00	-	-
100-300 friends online	**2.31**	**0.040**	**[1.04, 5.14]**	**2.57**	**0.022**	**[1.15, 5.76]**	**2.82**	**0.024**	**[1.15, 6.94]**
300+ Friends online	1.39	0.420	[0.63, 3.08]	1.59	0.257	[0.71, 3.56]	1.68	0.264	[0.68, 4.19]
MEDIUM FAMILY SUPPORT (N=632)									
No SNS profile	1.32	0.529	[0.55, 3.16]	1.39	0.465	[0.58, 3.34]	1.18	0.745	[0.44, 3.20]
Up to 100 friends online	1.00	-	-	1.00	-	-	1.00	-	-
100-300 friends online	0.69	0.292	[0.34, 1.39]	0.72	0.369	[0.36, 1.47]	0.60	0.211	[0.27, 1.33]
300+ Friends online	1.28	0.435	[0.69, 2.39]	1.39	0.308	[0.74, 2.61]	1.15	0.701	[0.56, 2.36]
HIGH FAMILY SUPPORT (N=643)									
No SNS profile	1.26	0.429	[0.71, 2.22]	1.30	0.373	[0.73, 2.30]	1.26	0.474	[0.67, 2.36]
Up to 100 friends online	1.00	-	-	1.00	-	-	1.00	-	-
100-300 friends online	0.71	0.186	[0.43, 1.18]	0.70	0.181	[0.42, 1.18]	0.62	0.085	[0.35, 1.07]
300+ Friends online	1.18	0.476	[0.74, 1.88]	1.25	0.348	[0.78, 2.00]	1.15	0.599	[0.69, 1.90]

a. Model 1: Unadjusted

b. Model 2: Adjusted for gender

c. Model 3: Additionally adjusted for ethnicity, SES, and school

d. Multinomial logistic regression: Base outcome – Average well-being

8.7.4 Interactions with Parental Monitoring

Tests of the interaction between parental monitoring and SNS use, IM use cyberbullying involvement, network size, and communication with strangers in associations with depressive symptoms, social anxiety symptoms, and mental well-being suggested evidence for a moderating effect of parental monitoring in the association between communication with strangers online and depressive symptoms and in the association between communication with strangers online and above average well-being. The interaction tests did not suggest a moderating effect of parental monitoring in any of the other associations between social media characteristics and mental health in the follow-up cross-sectional data.

Tests of the moderating effect of parental monitoring in associations between social media characteristics and depressive symptoms indicated a 53% reduction in odds of reporting depressive symptoms after adjustment for confounding variables among those who communicated with strangers and reported low levels of parental monitoring compared to those who reported medium-high parental monitoring (p=0.004, 95% CI [0.27, 0.78]). The stratified analyses displayed in Table 89 indicated that for those with medium-high levels of parental monitoring, communication with strangers online was associated with 2.49 times higher odds of depressive symptoms compared to those who did not communicate with strangers. Online communication with strangers was not associated with an increase in odds of reporting depressive symptoms among those with low levels of parental monitoring.

Table 89: Parental monitoring stratified analyses: OR and confidence intervals for the association between communication with strangers and depressive symptoms

	Model 1[a]			Model 2[b]			Model 3[c]		
	OR	**p-val**	**95%CI**	**OR**	**p-val**	**95%CI**	**OR**	**p-val**	**95%CI**
MEDIUM-HIGH PARENTAL MONITORING (N=1449)									
Does not communicate with strangers	1.00	-	-	1.00	-	-	1.00	-	-
Communicates with strangers	**2.46**	**<0.001**	**[1.90, 3.19]**	**2.44**	**<0.001**	**[1.86, 3.19]**	**2.49**	**<0.001**	**[1.89, 3.26]**
LOW PARENTAL MONITORING (N=398[d])									
Does not communicate with strangers	1.00	-	-	1.00	-	-	1.00	-	-
Communicates with strangers	1.20	0.371	[0.80, 1.81]	1.23	0.331	[0.81, 1.87]	1.22	0.401	[0.77, 1.92]

a. Model 1: Unadjusted
b. Model 2: Adjusted for gender
c. Model 3: Additionally adjusted for ethnicity, SES, and school
d. Schools 8 and 17 dropped – issues with perfect prediction (20 observations affected)

Those who communicated with strangers and reported low levels of parental monitoring had 2.79 times greater odds of reporting above average well-being compared to their peers with medium to high levels of parental monitoring in the fully adjusted model (p=0.013, 95% CI [1.24, 6.29]). Results of the stratified analyses (Table 90) indicate among those with low levels of parental monitoring, those who communicated with strangers online had a 2.93 times greater risk of reporting above average well-being compared to their peers who did not communicate with strangers online. The results did not provide evidence for an association between communication with strangers online and above average well-being among those with medium-high levels of parental monitoring.

Table 90: Parental monitoring stratified analyses: RRR and confidence intervals for the association between communication with strangers and above average well-being

	Above average well-being[d]								
	Model 1[a]			**Model 2[b]**			**Model 3[c]**		
	RRR	**p-val**	**95%CI**	**RRR**	**p-val**	**95%CI**	**RRR**	**p-val**	**95%CI**
MEDIUM-HIGH PARENTAL MONITORING (N=1402)									
Does not communicate with strangers	1.00	-	-	1.00	-	-	1.00	-	-
Communicates with strangers	0.83	0.281	[0.59, 1.16]	0.85	0.346	[0.61, 1.19]	0.85	0.372	[0.60, 1.21]
LOW PARENTAL MONITORING (N=407)									
Does not communicate with strangers	1.00	-	-	1.00	-	-	1.00	-	-
Communicates with strangers	**2.04**	**0.048**	**[1.00, 4.16]**	**2.01**	**0.055**	**[0.99, 4.10]**	**2.93**	**0.014**	**[1.24, 6.90]**

a. Model 1: Unadjusted
b. Model 2: Adjusted for gender
c. Model 3: Additionally adjusted for ethnicity, SES, and school
d. Multinomial logistic regression: Base outcome – Average well-being